...HNOLOGY DEPT.

POWER

POWER GENERATION, TRANSMISSION, APPLICATION AND THE ATTENDANT SERVICES IN ALL INDUSTRIES

JAN 13

JANUARY, 1942

Defend Your Plant—Practical program for plant protection in air raids and other emergencies outlined by Office of Civilian Defense (page 72)

Latest in Central-Station Design—exemplified by ingenious auxiliary services at Oswego (page 56) and by first commercial forced-circulation boiler at Somerset (page 90)

Scale Detective — Newly devised X-ray method shows source and composition of boiler scale and turbine deposits. Story on page 64 gives numerous examples of such analysis

How To Judge Used Diesel Oil — Knowledge of tests and their meaning (page 68) answers question "When shall I change the oil?" Other "How To" articles on figuring tricky pump heads (page 77) "torch-grooving" steel (page 114) and designing safe ramps (page 116)

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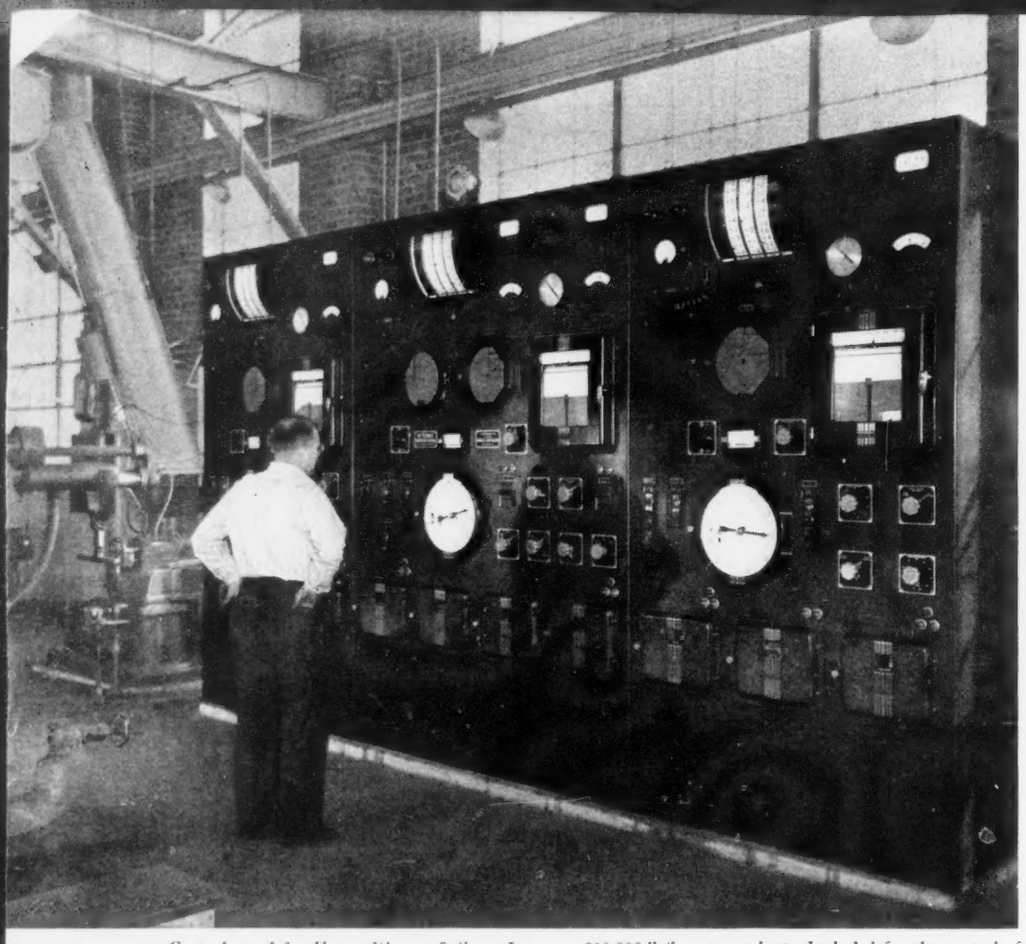


Control panel for Henry Disston & Sons, Inc. new 200,000-lb/hr power plant. Included for the control of their three Riley steam-generators are Metermax Combustion Control, Micromax Temperature Recorder and Micromax CO_2 Recorder.

NEW DISSTON POWER PLANT

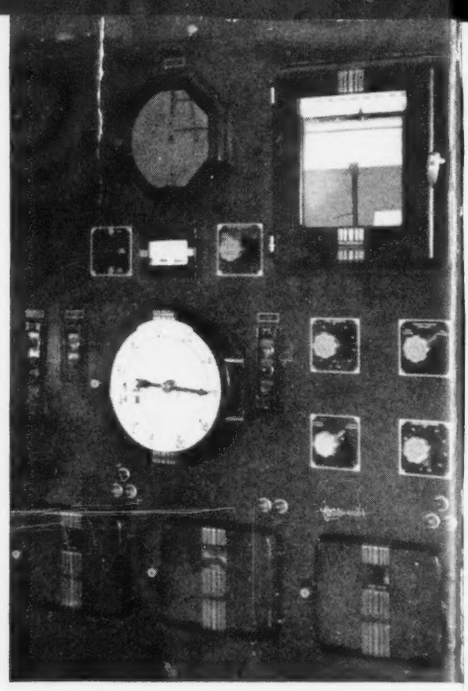
Instrumented Like a Central Station

When the Disston engineers came to the point of specifying the control instruments for their new 3-boiler, 200,000-lb/hr power plant, they were in something of a quandary. Not for many years had the Company purchased combustion controllers, CO_2 recorders, or steam-temperature recorders; and, without some experience in such devices to guide them, the proper selection was a problem.

But, Disston had long been using temperature-controlling instruments, in the melting, rolling, hardening and tempering of the steel used in the manufacture of saws, files, knives, armor plate, etc. Many dozens of those instruments were L&N, and were giving extremely satisfactory service. Why not, then, reach over into the manufacturing department's experience, and specify L&N for the power plant?

Operations to date have amply justified the decision. The Metermax Combustion Control gives boiler operators a control distinguished for completeness and flexibility; a control which handles even the heaviest load swings with ease and smoothness . . . The Micromax temperature recorders supply multipoint records of steam, water, flue gas and air, with the greatest dependability and with outstanding clearness and legibility . . . And the Micromax CO_2 Recorders are proving here, as they have proved in dozens of other plants, that CO_2 can now be recorded as easily, as accurately and with as little maintenance on the instrument as is the case with temperature.

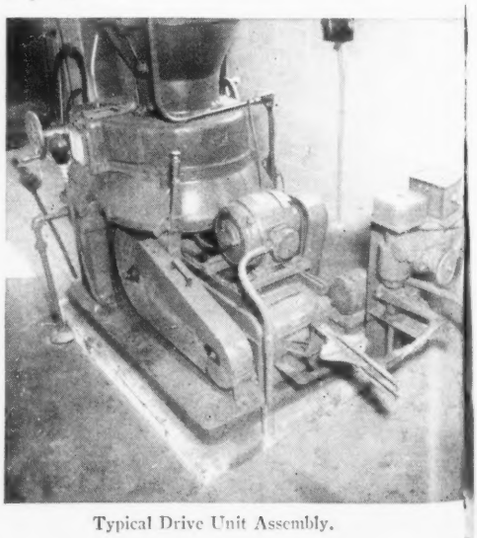
All these instruments are described in well-illustrated catalogs; just send for the ones which interest you.



Close-up of Panel

Many an engineer who likes the clear, sharp records of the Micromax Multi-point Temperature Recorder will be glad to know that those records can now be filed in such a way that they can be consulted without having to unroll the used chart. Recorders simply have a "tear-off device", which permits removal of chart every day, or as often as desired. Folded once, the torn-off 24-hour record fits a standard desk file. The strip-chart Micromax, shown above on the Disston control panel, has this tear-off device; the tape which is clipped to the torn edge reduces the consumption of chart paper to a minimum.

At the bottom of the panel are the Micromax Round-Chart CO_2 Recorder, the push-buttons for Metermax Combustion Control and the Controllers. These last instruments regulate the fuel feed, air flow and furnace pressure by means of electrically-powered drive units. A typical unit is shown herewith, as it is applied to the Atrita mill which feeds the Number One boiler. Further information about Metermax Control is given in Catalog N-01-163, which will be sent on request.



Typical Drive Unit Assembly.

Jrl. Ad. N-163(6)

LEEDS & NORTHRUP COMPANY, 4910 STENTON AVE., PHILA., PA.

LEEDS & NORTHRUP

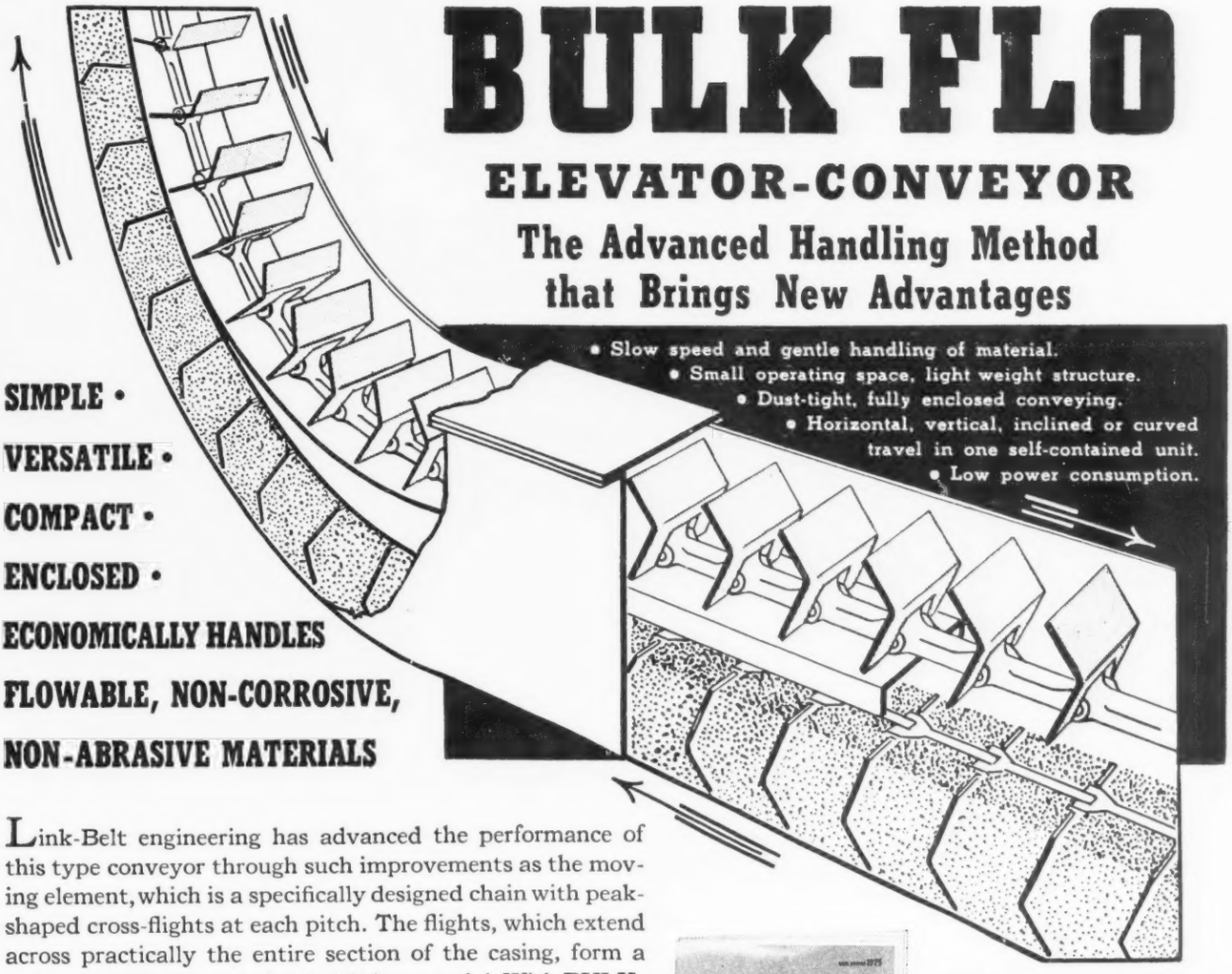
MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

POWER (with which are consolidated "Science and Industry," "The Engineer Review," "The Engineer," and "The Stationary Engineer"), January, 1942, Vol. 86, No. 1. Published monthly with an additional Directory number in December, McGraw-Hill Publishing Company, Inc. Publication office, 99-129 North Broadway, Albany, N. Y. Editorial and Executive offices, 330 West 42nd Street, New York, N. Y. Entered as second class matter August 25, 1936, at Post Office, at Albany, N. Y., under the act of March 3, 1879. Printed in U. S. A. Allow at least ten days for change of address. All communications about subscriptions should be addressed to the Director of Circulation, 330 West 42nd Street, New York, N. Y. Subscription rates—U. S. and U. S. Possessions, $3.00 for one year, $4.00 for two years. Canada, $3.50 for one year, $5.00 for two years. Great Britain and British Possessions 36 shillings per year. All other countries, $6.00 for one year, $9.00 for two years. 35c per copy.

BULK-FLO

ELEVATOR-CONVEYOR

The Advanced Handling Method that Brings New Advantages



- Slow speed and gentle handling of material.
- Small operating space, light weight structure.
- Dust-tight, fully enclosed conveying.
- Horizontal, vertical, inclined or curved travel in one self-contained unit.
- Low power consumption.

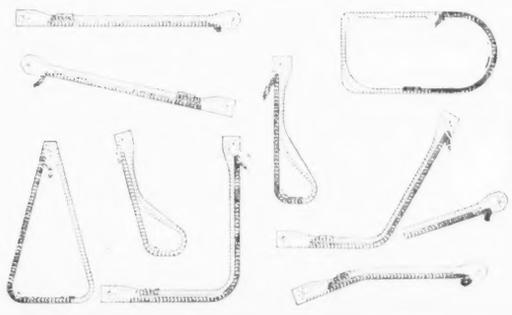
SIMPLE • VERSATILE • COMPACT • ENCLOSED • ECONOMICALLY HANDLES FLOWABLE, NON-CORROSIVE, NON-ABRASIVE MATERIALS

Link-Belt engineering has advanced the performance of this type conveyor through such improvements as the moving element, which is a specifically designed chain with peak-shaped cross-flights at each pitch. The flights, which extend across practically the entire section of the casing, form a series of compartments that hold the material. With BULK-FLO you get automatic feed; positive conveying at both full and partial loads; prompt, clean discharge without carry-over; and smooth, reliable, low-cost operation.

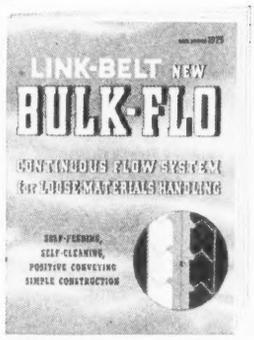
LINK-BELT COMPANY

Engineers and Manufacturers of Materials Handling and Mechanical Power Transmission Machinery Since 1875

Chicago, Philadelphia, Indianapolis, Atlanta, Dallas, San Francisco, Toronto
8671-A Offices, warehouses and distributors in principal cities



A single BULK-FLO installation may follow almost any path of travel. Typical arrangements are shown. Because of flexibility for movement in many directions, one continuous unit may be arranged instead of two or more units. In every case you get compact, space-saving design.


LINK-BELT NEW
BULK-FLO
CONTINUOUS FLOW SYSTEM for LOOSE MATERIALS HANDLING
SELF-FEEDING, SELF-CLEANING, POSITIVE CONVEYING SIMPLE CONSTRUCTION

This Book Is Important to You

If you are looking for an immediate simple, dustless, safe, clean, and economical method of handling granular, crushed, ground or pulverized materials of a loose, flowable, non-corrosive, non-abrasive nature, and are looking ahead to future materials handling economy, send for Book No. 1975.

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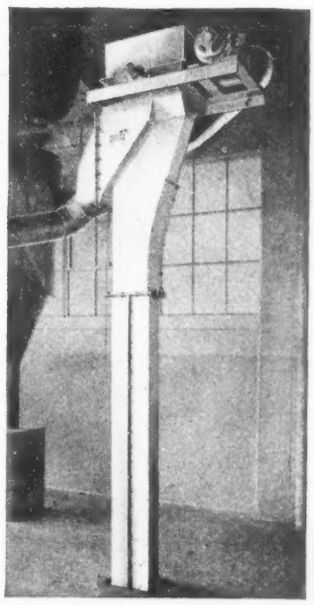
Head end of small BULK-FLO unit, showing compact, safe drive arrangement. ⟶



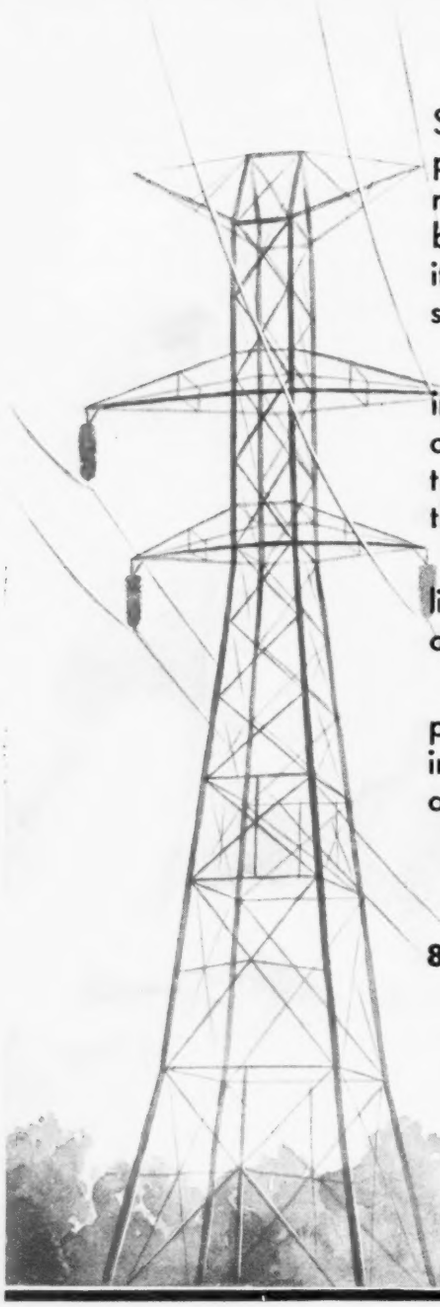
LINK-BELT CONVEYORS

LINK-BELT

EQUIPMENT INCLUDES: Elevators and Conveyors of all types . . . Coal and Ashes Handling Equipment . . . Automatic Coal Stokers . . . Vibrating Screens . . . Roto-Louvre Heat Dryers and Coolers . . . Skip Hoists . . . Car Spotters and Haulage Systems . . . Portable Conveyors and Bucket Loaders . . . Silent and Roller Chain Drives . . . Speed Reducers . . . Variable Speed Transmissions . . . Chains and attachments of all types (malleable Iron, Promal and Steel) . . . Sprockets . . . Gears . . . Clutches . . . Couplings . . . Friction Fighter Self-aligning Ball and Roller Bearings . . . Babbitted Bearing Units . . . Base Plates . . . Take-Ups, Shafting, etc.

B&W BOILERS AT OSWEGO

help Niagara carry the load



Stand-by and peak-load service and, in addition, one-boiler-per-turbine operation places requirements beyond the ordinary upon steam boilers. Such are the conditions being met by two B&W Radiant Boilers of 900,000 lb. per hour capacity each in Oswego Steam Station, the new and outstanding station of the Niagara-Hudson Power System.

The station is designed to provide maximum flexibility in operation — to carry maximum load during low flow at the system's hydroplants, minimum load of 4000 kw per turbine on stand-by, and rapidly varying load between these extremes.

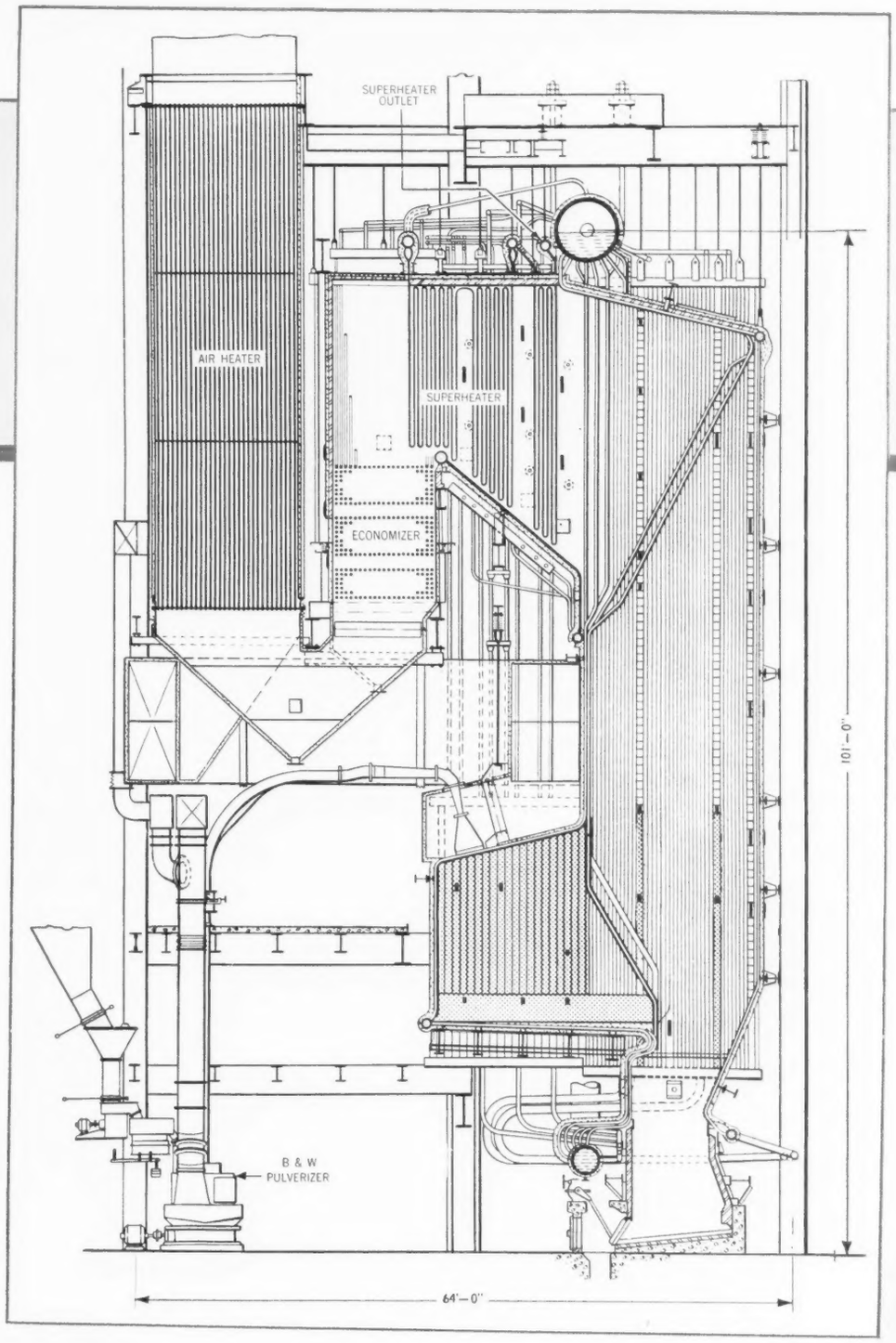
The reliability of the boilers in this service is well established, base loads are handled efficiently, and sudden and abnormal steam demands are met satisfactorily.

A feature that contributes prominently to the successful performance of the boilers is the arrangement of the heating surface and proportioning of the furnace for maximum absorption of radiant heat and minimum slagging.

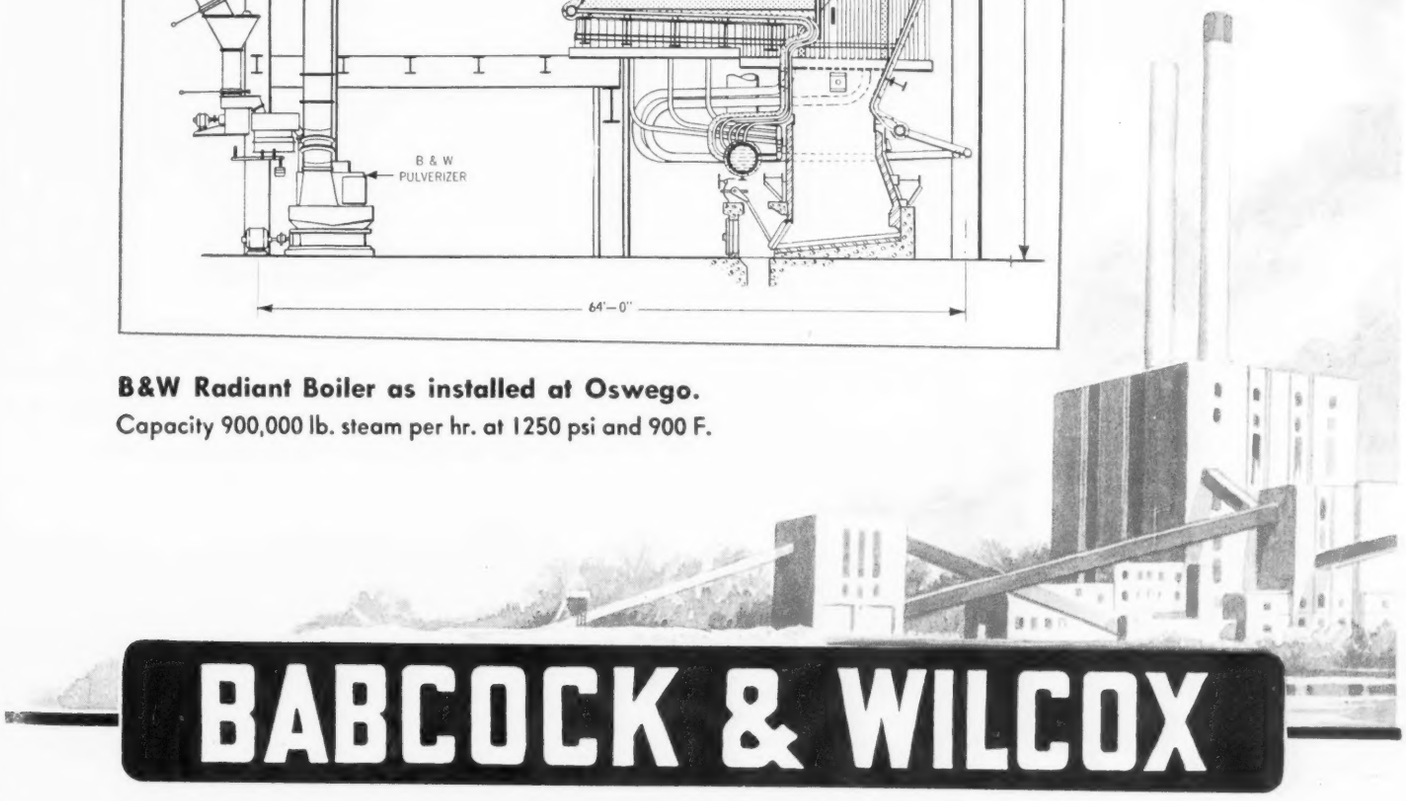
Forty-four other Radiant Boilers are in service or on order.

THE BABCOCK & WILCOX COMPANY
85 Liberty Street **New York, N. Y.**

G-216T



B&W Radiant Boiler as installed at Oswego.
Capacity 900,000 lb. steam per hr. at 1250 psi and 900 F.

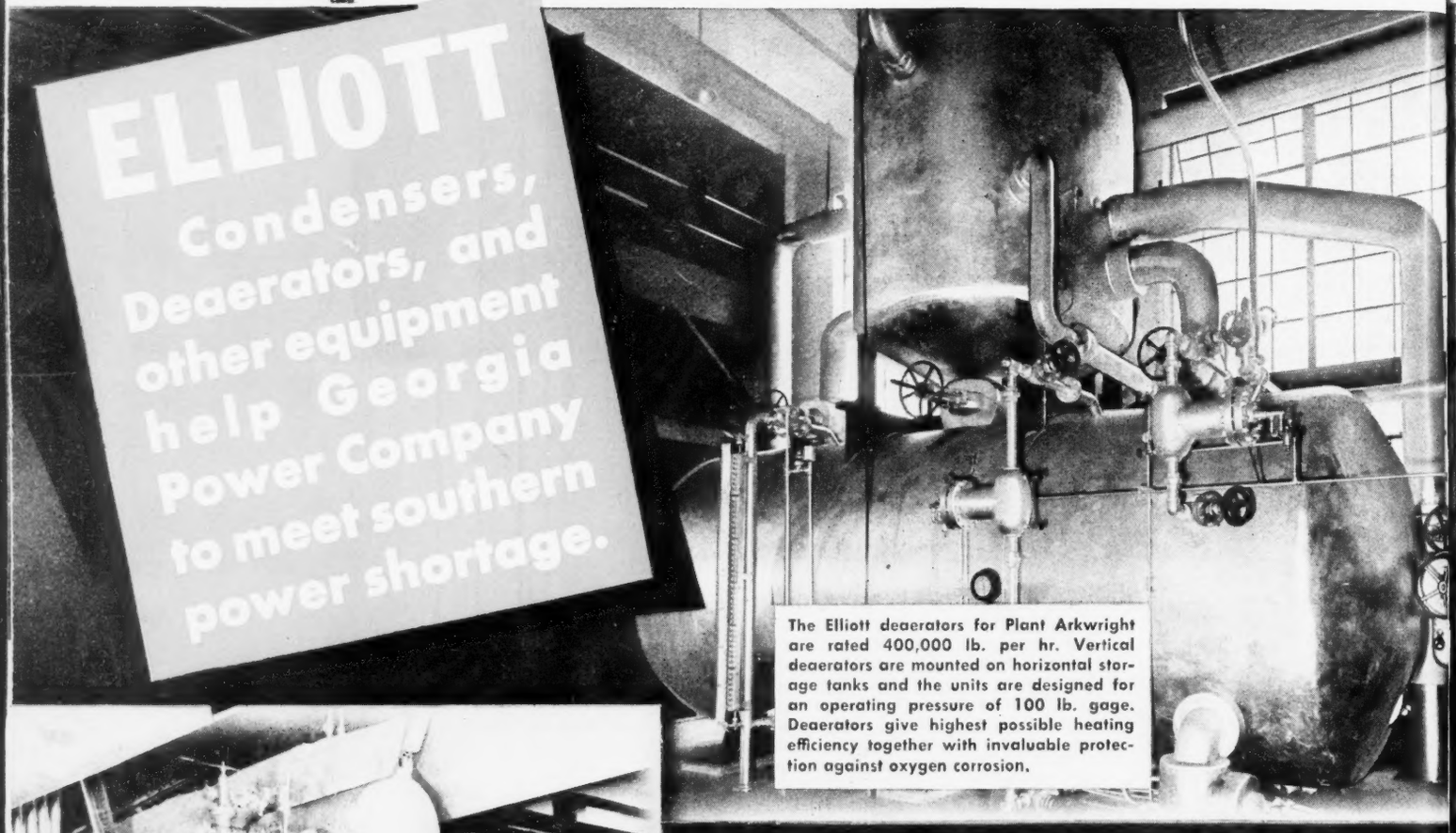


BABCOCK & WILCOX

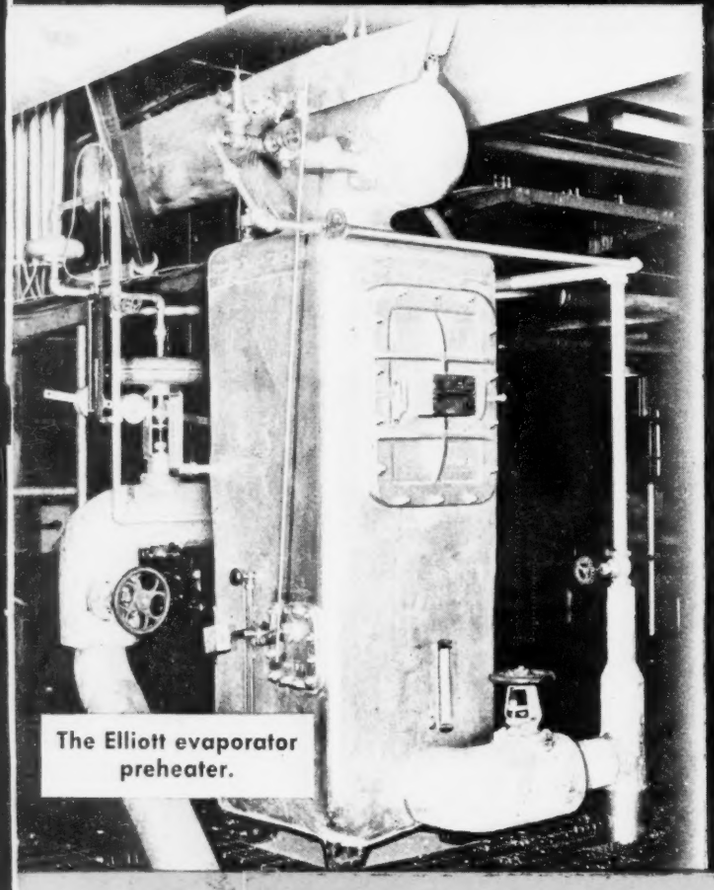
Dependable STEAM

ELLIOTT

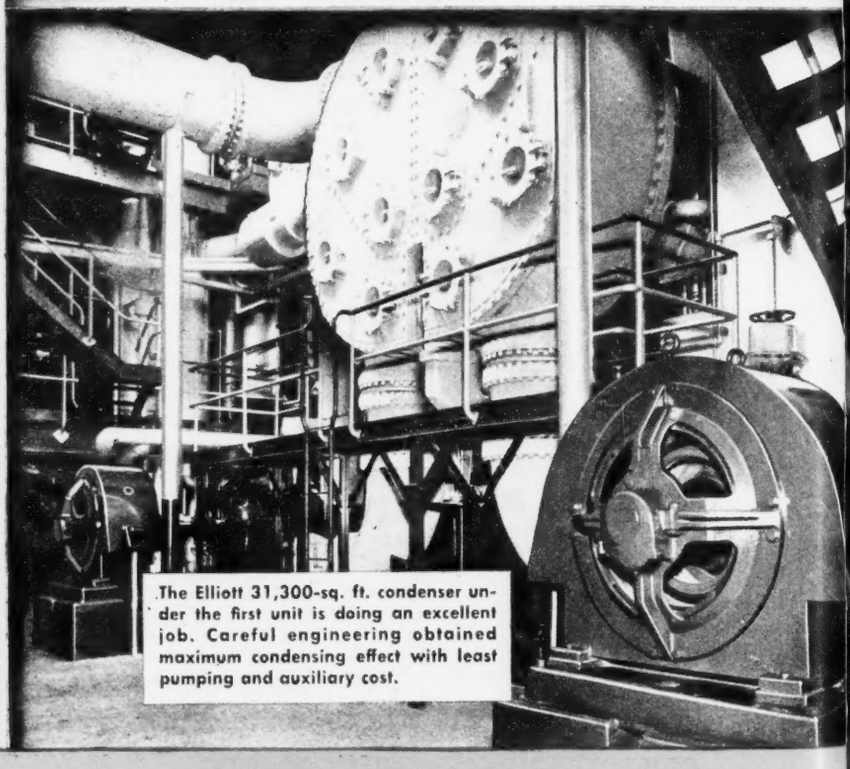
Condensers, Deaerators, and other equipment help Georgia Power Company to meet southern power shortage.



The Elliott deaerators for Plant Arkwright are rated 400,000 lb. per hr. Vertical deaerators are mounted on horizontal storage tanks and the units are designed for an operating pressure of 100 lb. gage. Deaerators give highest possible heating efficiency together with invaluable protection against oxygen corrosion.



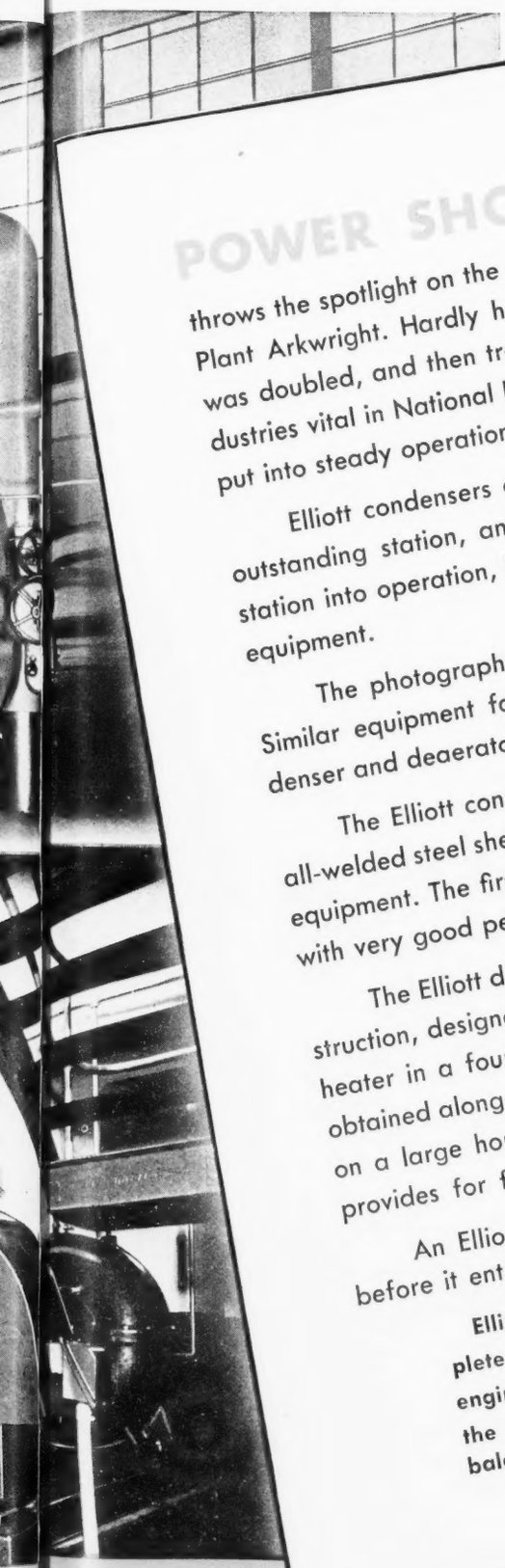
The Elliott evaporator preheater.



The Elliott 31,300-sq. ft. condenser under the first unit is doing an excellent job. Careful engineering obtained maximum condensing effect with least pumping and auxiliary cost.

ELLIOTT

POWER *to the rescue!*



POWER SHORTAGE IN THE SOUTH

throws the spotlight on the new outstanding station of the Georgia Power Company, Plant Arkwright. Hardly had this station been planned before its original capacity was doubled, and then trebled. In order to get power as quickly as possible for industries vital in National Defense, the station was built and the first 40,000-kw. unit put into steady operation in remarkably short time, at full rated capacity.

Elliott condensers and deaerators are important parts of the equipment of this outstanding station, and Elliott Company is glad to have assisted in speeding the station into operation, by making deliveries on time, and rushing the erection of its equipment.

The photographs show installations of the first Elliott condenser and deaerator. Similar equipment for the second 40,000-kw. unit is on the job, while a third condenser and deaerator are being hurried on their way to completion.

The Elliott condensers are 31,300-sq. ft. two pass, divided water-box units with all-welded steel shells, served by Elliott twin two-stage steam jet ejectors and auxiliary equipment. The first condenser is operating continuously under rather large overload with very good performance.

The Elliott deaerators for the station are of A.S.M.E. Code Class 1 welded construction, designed for an operating pressure of 100 lb. gage. They act as the No. 3 heater in a four-stage extraction heating cycle. Thus "zero" oxygen deaeration is obtained along with feed heating at incidental cost. The vertical deaerator is mounted on a large horizontal storage tank which acts as the surge tank for the system and provides for feedwater additions or rejection.

An Elliott 12,000-lb.-per-hr. evaporator preheater deaerates make-up water before it enters the evaporator.

Q-1081

Elliott condensers and deaerators are built in a complete range of sizes for plants large or small, and our engineers are glad to co-operate with you in selecting the right type and size equipment to fit into your heat balance requirements.

COMPANY

JEANNETTE, PA., RIDGWAY, PA.
SPRINGFIELD, OHIO
District Offices in Principal Cities

PRODUCTS: TURBINE-GENERATORS • MECHANICAL DRIVE TURBINES • ENGINES • ENGINE-GENERATORS
MOTOR-GENERATORS • MOTORS • GENERATORS • CONDENSERS • STEAM JET EJECTORS • DEAERATORS
FEED-WATER HEATERS • DEAERATING HEATERS • CENTRIFUGAL BLOWERS • TURBO-CHARGERS • DESUPERHEATERS
STRAINERS • SEPARATORS • GREASE EXTRACTORS • NON-RETURN VALVES • LAGONDA-LIBERTY TUBE CLEANERS

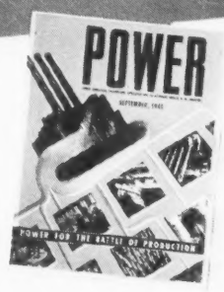
Typical Central Stations Installed or

Compiled by S A Tucker
Associate Editor

Company	Location	Plant Name	Consulting Engineers	Part Operation, New Units	Nominal Pressure, Lb	Nominal Steam Temperature, F	BOILERS Number	BOILERS Capacity, Each, 1000 Lb per Hr	BOILERS Manufacturer	Furnace Volume, 1000 Cu Ft	
1000 LB AND ABOVE											
Consolidated Edison Co, N Y	New York, N Y	Sherman Creek		1942	1625	950	1	925	CE	53	ST
Public Service Elec & Gas Co	Burlington, N J	Burlington		11-42	1475	950	2	550	BW	23.5	ST
Public Service Elec & Gas Co	Jersey City, N J	Marion		12-42							
Boston Edison Co	Everett, Mass	Mystic		8-42	1400	910	1	430	CE		
Boston Edison Co	South Boston, Mass	L Street	Jackson & Moreland		1400	910	1	560	CE	31.5	DB
Metropolitan Edison Co	West Reading, Pa	West Reading	Jackson & Moreland	9-41	1400	900	2				DB
Pacific Gas & Electric Co	San Francisco, Calif	Oleum		1943	1400	950	3	275	CE	16.9	DB
Appalachian Elec & Power Co	Cabin Creek, W Va	Cabin Creek	Am G & E Serv Corp	6-42	1375	950	4	300	BW		DB
Ohio Power Co	Philo, Ohio	Philo	Am G & E Serv Corp	1942	1375	950	2	450	FW	23.8	DB
Deepwater Light & Power Co	Deepwater, N J	Deepwater	Am G & E Serv Corp	1-42	1350	950	2	450	BW	19.8	DB
Penn Power & Light Co	Harrisburg, Pa	Cedar	Ebasco Services	6-41	1325	765	1	550	BW	48.5	DB
Wisconsin Electric Power Co	Port Washington, Wis	Port Washington	Wis Elect Pwr Co			930	2	185	CE	8.09	DB
San Antonio Public Serv Co	San Antonio, Tex	Station B	United Lt & Pr Serv Co	11-42	1325	850	1	690	CE	60.0	DB
Buffalo Niagara Elect Corp	Buffalo, N Y	Huntley	Sargent & Lundy	2-43	1325	900	1	275	BW	14.1	DB
Commonwealth Edison Co	Chicago, Ill	Fisk	Sargent & Lundy	1942	1250	900	1	900	BW	37.7	ST
Commonwealth Edison Co	Chicago, Ill	Fisk	Sargent & Lundy	10-43	1250	900	1	750	CE	48.0	ST
Monongahela West Penn P S Co	Rivesville, W Va	Rivesville	Sargent & Lundy	11-42	1250	925	2	900	BW	46.0	ST
Philadelphia Electric Co	Chester, Pa	Chester	Sanderson & Porter	10-42	1250	925	2	750	CE	48.0	ST
				1942	1250	925	2	750	BW	23.8	DB
					250	570	1	400	FW	27.0	DB
							1	600	BW		ST
850 TO 999 LB											
Alabama Power Co	Chickasaw, Ala	Chickasaw	C & S Corp	1942	950	900	1	400	CE		
Georgia Power Co	Macon, Ga	Arkwright	C & S Corp	3-42	950	900	1	400	CE		DB
Georgia Power Co	Macon, Ga	Arkwright	C & S Corp	6-43	950	900	1	400	CE		DB
							1	400	BW	22.3	DB
Connecticut Light & Power Co	Devon, Conn	Devon	Duke Power Co	1942	950	900	2	225	CE	12.4	DB
Duke Power Co	Spencer, N C	Buck	C & S Corp	7-42	950	900	1	375	CE	19.3	DB
Southern Ind Gas & Elect Co	Evansville, Ind	Ohio River	Burns & Roe	9-42	925	900	1	225	RS	12.4	DB
Jersey Central Pwr & Lt Co	Sayreville, N J	Raritan River	Burns & Roe	1941	900	900	1	400	BW	15.4	ST
Jersey Central Pwr & Lt Co	Sayreville, N J	Raritan River	Ebasco Services	1943	900	900	1	400	BW	15.4	ST
Carolina Power & Light Co	Moncure, N C	Cape Fear	C & S Corp	1942	900	900	2	300	RS		
Consumers Power Co	Undetermined	Undetermined	Gibbs & Hill	1943	875	900	1	550	FW		ST
Indianapolis Pwr & Lt Co	Indianapolis, Ind	Harding St									DB
Consumers Power Co	Bay City, Mich	John C Weadock	C & S Corp	8-42	875	900	1	550	FW		
Tampa Electric Co	Tampa, Fla	W Jackson St	Stone & Webster	8-42	860	830	1	160	BW	6.7	DB
Alabama Power Co	Gorgas, Ala	Gorgas No 2	C & S Corp	3-43	850	900	1	160	BW		DB
Northern States Power Co	St Paul, Minn	High Bridge	P U Engrg & Serv	11-41	850	900	1	650	BW	37.5	DB
New Bedford Gas & Edison Co	New Bedford, Mass	New Bedford	E M Gilbert Engrg Corp	2-42	850	900	1	450	BW		ST
Tennessee Valley Authority	Watts Bar Dam, Tenn	Watts Bar	Chas T Main	11-41	850	825	2	150	BW	37.5	DB
					850	900	3	600	BW		ST
Consol Gas Elec Lt & Pr Co	Baltimore, Md	Riverside	Stone & Webster	11-42	850	900	1	550	BW	28.95	DB
Duquesne Light Co	Wireton, Pa	Frank R Phillips		4-42	850	900	2	300	FW	25.4	DB
Hartford Electric Light Co	Hartford, Conn	South Meadow		9-42	850	900	1	450	BW	19.9	DB
Philadelphia Electric Co	Philadelphia, Pa	Southwark		1943	850	900	2	850	BW	40.5	ST
Philadelphia Electric Co	Philadelphia, Pa	Southwark		1943	850	900	2	850	BW	40.5	ST
Virginia Electric & Power Co	Norfolk, Va	Reeves Avenue	Stone & Webster	10-41	850	875	1	450	CE	23.6	ST
Detroit Edison Co	Marysville, Mich	Marysville		12-42	815	900	3	440	CE		DB
650 TO 849 LB											
Ohio Edison Co	Akron, Ohio	Gorge	C & S Corp	10-42	880	850	1	450	BW		
N Y State Electric & Gas Corp	Dresden, N Y	Greendge	Atl Ut Serv Corp		700	825	1	220	FW		DB
Virginia Public Service Co	Alexandria, Va	Alexandria		7-42	700	825	2	80	CE	12.2	DB
Potomac Electric Power Co	Washington, D C	Buzzard Point								3.6	
Interstate Power Co	Dubuque, Iowa	Dubuque		1942	690	900	1	525	CE	25.0	ST
Wisconsin Public Service Corp		Bayside		12-41	675	900	1	150	CE	9.8	DB
Rochester Gas & Elec Corp	Rochester, N Y	Rochester #3	E M Gilbert Engrg Corp	7-42	675	900	1	310	BW		DB
Cincinnati Gas & Elect Co	Cincinnati, Ohio	Columbia	Columbia Engrg Corp	1942	660	825	1	300	CE		DB
Superior Water, Lt & Pwr Co	Superior, Wis	Winslow	Ebasco Services	7-42	650	900	2	350	BW	4.8	ST
Kansas City Power & Light Co	Kansas City, Mo	Grand Avenue	United Lt & Pr Serv Co	2-42	650	825	1	125	CE	6.1	DB
Louisville Gas & Electric Co	Louisville, Ky	Canal	PU E & S Corp	7-43	650	950					
Louisville Gas & Electric Co	Louisville, Ky	Paddy's Run	PU E & S Corp	11-41	650	900	1	312	CE	20.3	DB
United Illuminating Co	Bridgeport, Conn	Steel Point	Westcott & Mapes	5-42	650	900	2	312	CE	20.3	DB
				10-43	650	860	2	150	BW	8.3	DB
400 TO 649 LB											
Iowa Elect Light & Power Co	Boone, Iowa	Boone	John W Drabelle	10-43	600	750	2	130	SB		
Mayaguez Lt, Pr & Ice Co	Mayaguez, P R	Plant No 2		6-42	600	825	1	55	CE	7.4	DB
Interstate Power Co	Albert Lea, Minn	Albert Lea	Sargent & Lundy	12-41	450	825	1	90	CE	1.5	DB
Long Island Lighting Co	Glenwood Ldg, N Y	Glenwood	Burns & Roe	11-41	450	800	1	550	BW		DB
Porto Rico RR, L & Pwr Co	San Juan, P R	Santurce	Montreal Engrg Co	8-41	450	750	2	110	BW	39.9	DB
Union Public Service Co	Caddy, Minn		R D Thomas & Assoc	12-41	450	750	2			3.4	
Central Ohio Lt & Pwr Co	Bluffton, Ohio		Sargent & Lundy	1-41	450	750					
Columbus & South Ohio Elec Co	Columbus, Ohio	Woodcock	United Lt & Pr Serv Co	1-42	425	825	1	90	RS		
Interstate Power Co	Clinton, Iowa	Fenway		8-41	400	750				5.4	DB
		Clinton		6-43	400	825	1	45	RS		
Oklahoma Gas & Elect Co	Oklahoma City, Okla	Arthur S Huey	PU E & S Corp							3.3	DB
BELOW 400 LB											
Central Power & Light Co	Corpus Christi, Texas	Sucree Bay	Sargent & Lundy	3-42	390	845	1	175	BW		
Central Power & Light Co	Corpus Christi, Texas	Sucree Bay	Sargent & Lundy	10-42	390	845	1	175	BW		
Public Service Co of Colo	Boulder, Colorado	Valmont		1941	350	835	1	175	BW		
San Diego Gas & Electric Co	San Diego, Calif	Station B		9-41	250	750	2	300	BW	18.4	DB, ST
Lake Superior District Power Co	Ashland, Wis	Valmont		9-41	250	700	1	200	BW	8.2	
		Bay Front	Middle West Serv Co	9-41	225	550	1	120	RS	4.0	

A — Air cooling
Ab — Aluminum bronze
AC — Allis-Chalmers Mfg Co
Ad — Admiralty
BW — Babcock & Wilcox Co
C — Coal, bituminous
CA — Coal, anthracite
CE — Combustion Engineering Co
CP — Arsenical copper
D — Damper
DB — Dry bottom
DL — De Laval Steam Turbine Co
Du — Duplex
EC — Erie City Iron Works
EL — Elliott Co
FW — Foster Wheeler Corp
G — Gas
GE — General Electric Co
H — Hydrogen cooling
Hy — Hydraulic coupling
M — Motor drive
Mg — Magnesium

MORE THAN 82% OF THE SOOT BLOWERS PURCHASED FOR THESE PLANTS ARE DIAMOND



List published in POWER September, 1941

Unde[r] Construc[tion] [S]ince July, 1940

| FD FANS | | | | FUEL | | | |

THREE "EXTRA PROTECTION" FEATURES GIVE EVERY TRI CLAD MOTOR GREATER STRENGTH AND LONGER LIFE

1 Extra Protection against physical damage

2 Extra Protection against electrical breakdown

3 Extra Protection against operating wear and tear

ARMORED CONSTRUCTION . . . SMOOTH CONTOURS . . . RIGID ALIGNMENT

Strong, one-piece, cast-iron frame and cast end shields, with upper portion completely enclosed, protect vital motor parts from external blows, falling objects, or dripping liquids. There's less chance of damage in installation, or in operation under "slam-bang" conditions.

"FORMEX" WINDINGS . . . BONDED COIL UNITS

Stator windings of Formex wire give extra protection against moisture oil, abrasion, and heat-shock. New synthetic-resin bonding varnish and Glyptal No. 1201 Red on end-turns add to durability. You can count on uninterrupted performance and long life under strenuous conditions.

NEW BEARING DESIGN . . . ONE-PIECE, DYNAMICALLY BALANCED ROTOR

Sleeve bearings proportioned and grooved for protective lubrication under severe loads. Sleeve and ball bearings enclosed in strong, dust-tight housings. One piece rotor, with fans cast integrally, has new electrical and mechanical features assuring smooth, cool operation and high efficiency.

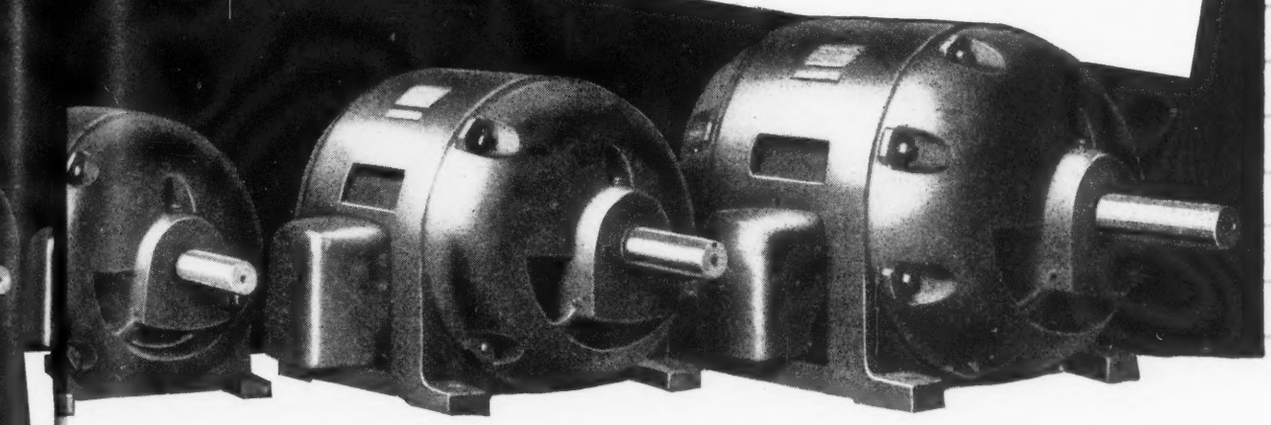
GENERAL ELECTRIC COMPANY, SCHENECTADY, N. Y.

BUILT FOR PROTECTION FIRST . . . TO LAST

up!

NOW . . . . .

TRI/CLAD polyphase induction motors are available in integral-hp sizes through . . . . **75 hp**



75 hp
60 hp
50 hp
40 hp
30 hp
25 hp
20 hp
15 hp
10 hp
7½ hp
5 hp
3 hp
2 hp
1½ hp
1 hp

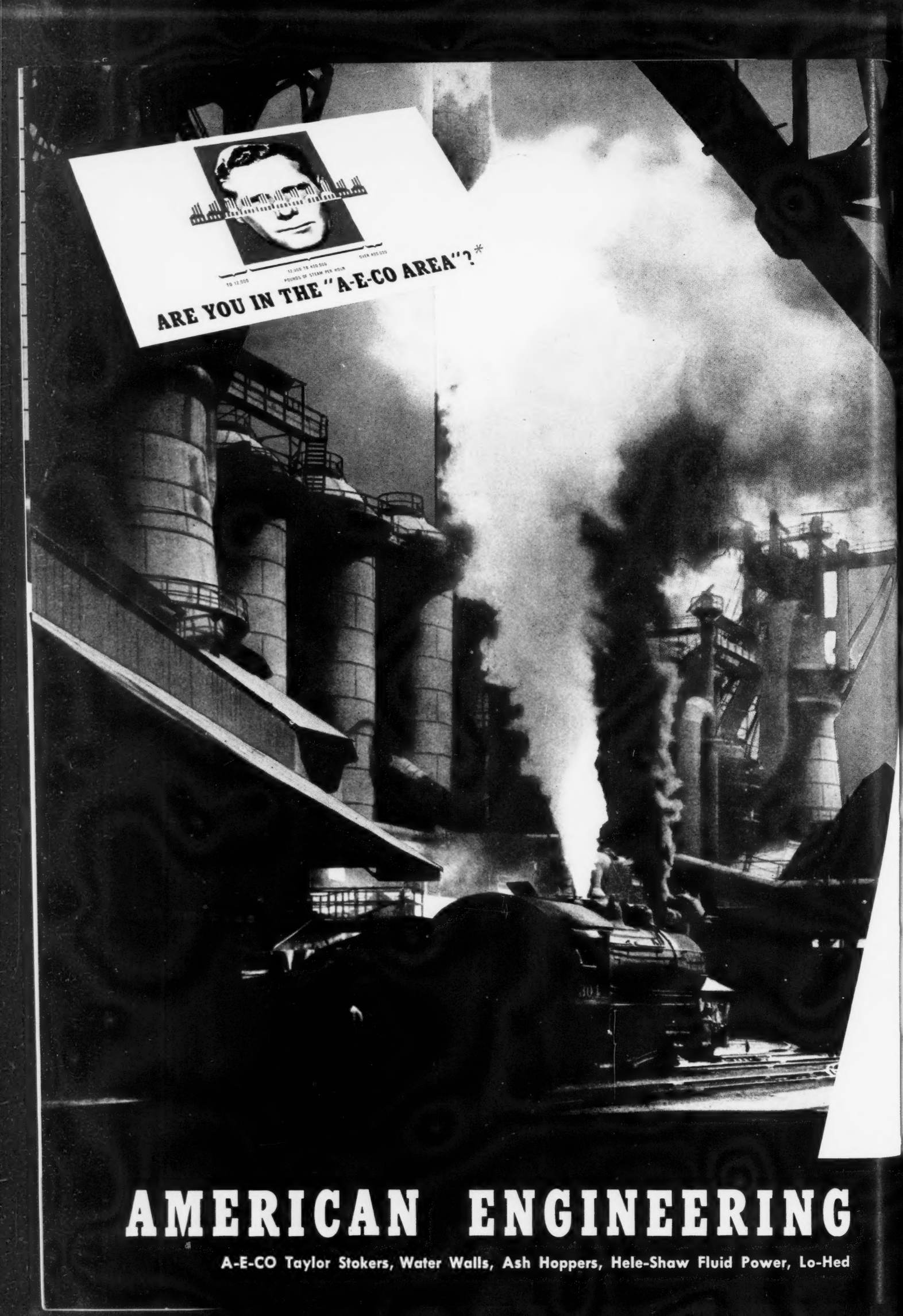
. . . a LARGER range of sizes!

. . . a WIDER scope of service!

The advanced design and triple-tough construction that won industry's enthusiastic acceptance almost overnight have now been extended to many larger motors in our a-c line.

General Electric and its employees are proud of the Navy award of Excellence made to its Erie Works for the manufacture of naval ordnance.

GENERAL ELECTRIC



AMERICAN ENGINEERING

A-E-CO Taylor Stokers, Water Walls, Ash Hoppers, Hele-Shaw Fluid Power, Lo-Hed

BUT WHAT ABOUT "after"—?

Production!... Production!... Production!... Every ounce of energy ... every capacity for output is the crying demand of today ...

But some day there'll be a change! As far as a fuel firing system is concerned, it is important to consider today only that equipment which can operate at a maximum capacity over a long period and yet which can be reduced efficiently in the future —without using oil or gas to get down to low steaming rates.

Taylor Stokers offer you precisely that advantage for today—or tomorrow. You can vary capacity by a wide range on a Taylor Stoker without alteration of fuel. You can operate at minimum or maintain peak with comparatively little difference in horsepower and slagging. A minimum of power is diverted to unproductive auxiliary drives.

For this reason, and for many others, TODAY'S TREND IS TO TODAY'S TAYLOR STOKER! Investigate *all* the facts! With all the facts before you, decide then whether or not Taylor Stokers provide the most satisfactory "balance of power" requirements for your specific purpose. In increasing numbers, steam plant operators all over the country are turning to Taylor for efficient production today—and "after"!

**If you operate between 12,000 and 400,000 pounds of steam per hour or more, you are in the A-E-CO Area! You must carefully investigate and compare every advantage of today's Taylor Stoker with ANY other fuel burning equipment!*

SEND FOR FREE BULLETINS—giving facts on each of the 12 factors influencing economical, continuous steam generation. Indicates the "balance of power" requirements for your own plant. Write American Engineering Co., 2400 Aramingo Ave., Phila., Pa.

Use These 12 Factors as a "Check Chart" in Demanding FACTS About Any Fuel Firing Equipment

RELIABILITY The Taylor Stoker has a 35 year record of reliability of which 92.7% is typical.

CAPACITY Emergency reserve capacity is readily available over long periods of operation.

MAINTENANCE Average is 3.4c per ton based on a recent study of a typical group of plants.

FLEXIBILITY From 40,000 to 300,000 lbs/hr in 72 seconds. Cold boiler, no fire, to 250% rating in 20 minutes.

EFFICIENCY 16.73c for fuel per thousand pounds of steam is indication of A-E-CO Taylor Stoker "dollar" efficiency.

OPERATION Simplest of any. No complicated adjustments. Coal direct from mine to hopper.

ADAPTABILITY Modernization can be accomplished without seriously disturbing existing plant structure.

FUEL FLEXIBILITY Handles coals of widely varying characteristics; detailed list on request.

REFUSE DISPOSAL Choice of 3 methods; power dump, continuous and rotary.

STACK DISCHARGE 90% average of ash to ash pit. Dust-recovery equipment rarely used —even in heart of city locations.

SPACE REQUIREMENTS Conforms to short and wide, or long and narrow furnaces.

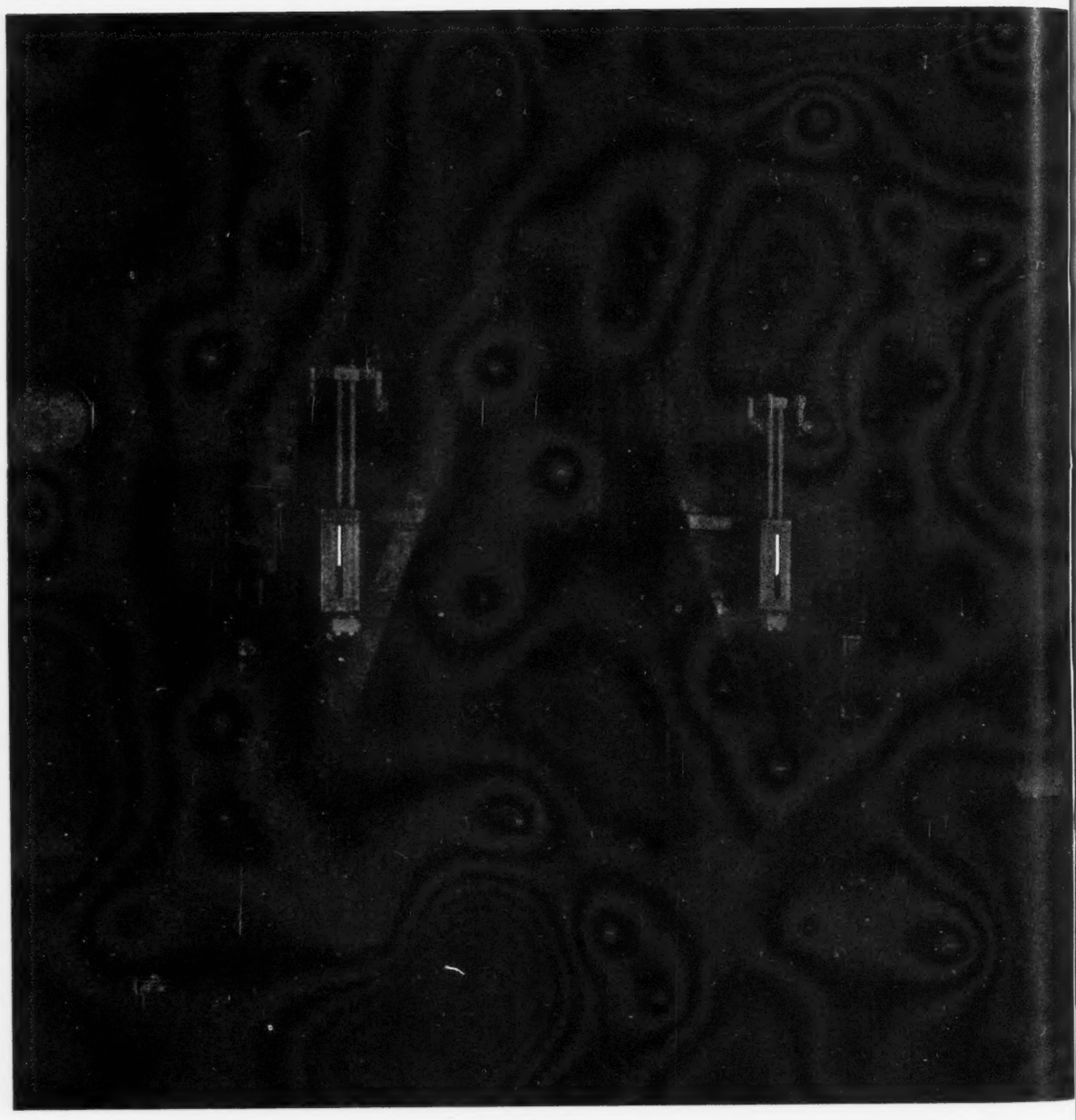
OBSOLESCENSE One basic design used for 35 years enables new improvements to be added to numerous existing installations.

THE A-E-CO Taylor Stoker

COMPANY

Hoists, Marine Deck Auxiliaries

EYE-HYE—your black-out defense



★
★
★

Reliance

against vital power stoppages

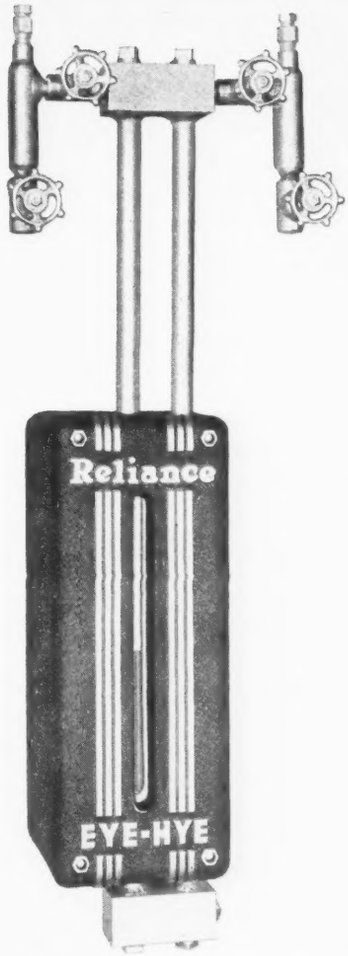
Make sure your boiler water levels are checked unfailingly. EYE-HYE carries the true reading to men on the boiler room floor—saves time and steps—accurate on all pressures

THE TECHNIQUE of rendering whole cities invisible from the air, no longer a fantastic idea in this country, has accentuated special needs for point-of-service illumination. The general lighting of high-ceilinged many-windowed power plants and factories is difficult to hide. It means "lights out" in a very complete sense of the word.

In actual blackout rehearsals, men have been stationed at instrument panels, control stations and even up by the boiler water columns to keep vigil with flash lights. Uncomfortable?... hazardous?... inefficient? Yes! But engineers have learned that the Reliance EYE-HYE solves the most difficult problem — reading water levels ordinarily gaged at the drum — by bringing the reading *down* to a safe, convenient position *at eye level!*

This popular Remote Reading Gage shows the water in illuminated green liquid and the steam or empty space in clear white light — an accurate, easy-to-read indication, yet without sufficient spread of light to illuminate the space in front of it. Dozens of EYE-HYEs have actually been ordered for the specific purpose of checking water levels during blackouts — but thousands of EYE-HYEs, both stationary and marine, have gone on the job to help protect the priceless flow of power in these critical times. Don't risk water level accidents in your plant — write for full description of the EYE-HYE, *Bulletin 382.*

THE RELIANCE GAUGE COLUMN COMPANY • CLEVELAND, OHIO

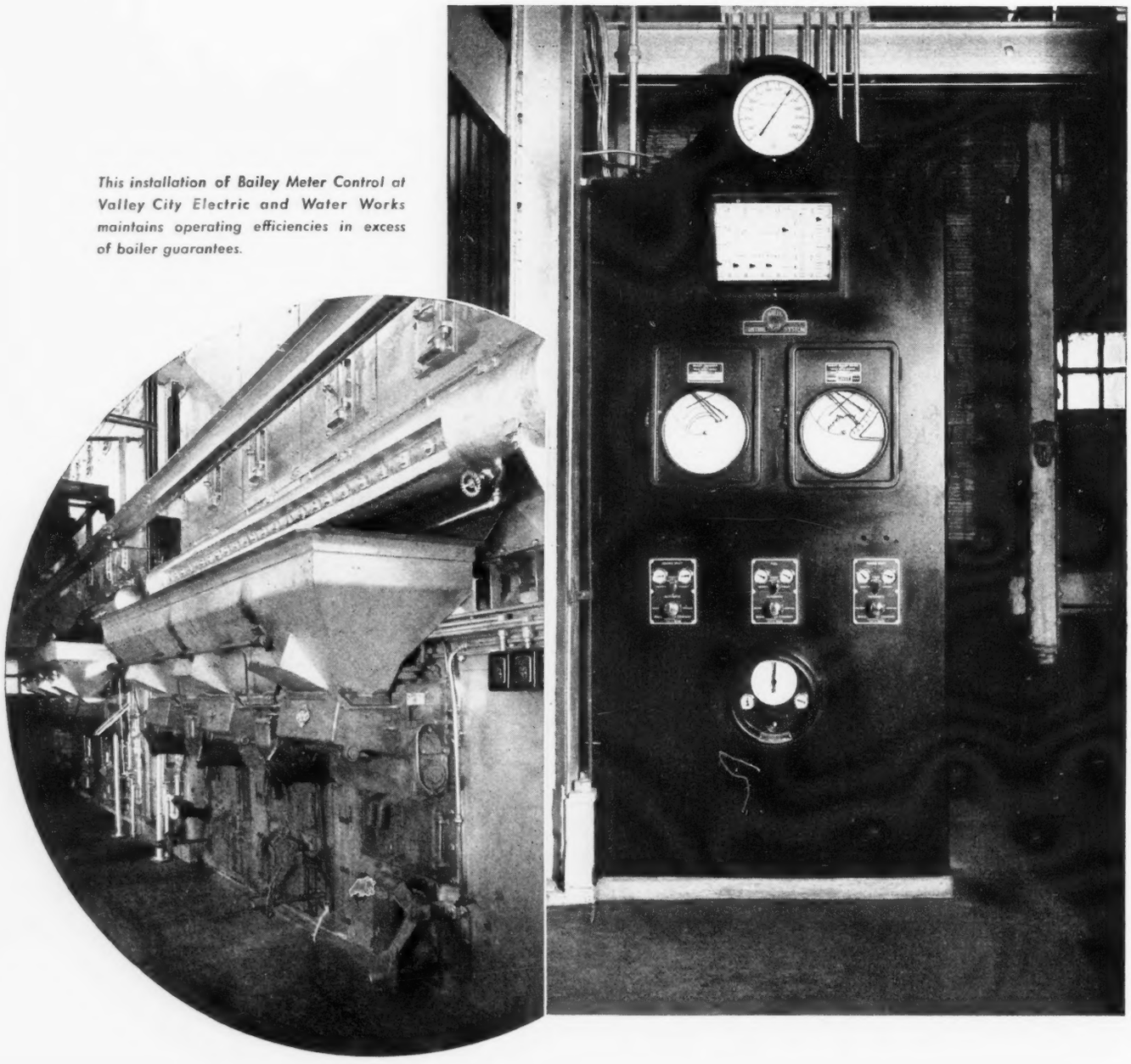


EYE-HYE *is connected through two flexible tubes which can follow the most convenient route — around pipes and girders, and through walls — to the drum. Reliance Unitemp makes* **EYE-HYE** *absolutely dependable. . . Models for wall or panel mounting.*

★
★
★

BOILER SAFETY DEVICES

"BETTER THAN



This installation of Bailey Meter Control at Valley City Electric and Water Works maintains operating efficiencies in excess of boiler guarantees.

BAILEY METER CONTROL...

BOILER METERS • MULTI-POINTER GAGES • FLUID METERS • RECORDERS • SUPERHEAT

GUARANTEE EFFICIENCY"

High Yearly Average Credited to *BAILEY METER CONTROL*

★ Sustained operating efficiencies in excess of boiler guarantees are being obtained at the Valley City Electric and Water Works Plant, Valley City, North Dakota. According to Mr. O.N. Bergman, Superintendent, Bailey Meter Control has kept his two new 60,000 pound per hour capacity 420 pound pressure, spreader stoker-fired boilers operating at better than guarantee efficiency since they were placed in service over a year ago.

The fuel economy of such performance is only one of the many benefits resulting from the plus values of Bailey Meter Control. Other benefits are:

1. Maximum steaming capacity always available.
2. Boiler outage reduced to a minimum.
3. Furnace refractories protected from excessive temperatures.
4. Prime movers favored by steam at design conditions.
5. Added protection against furnace explosion.
6. Normal operation automatically maintained during emergencies.

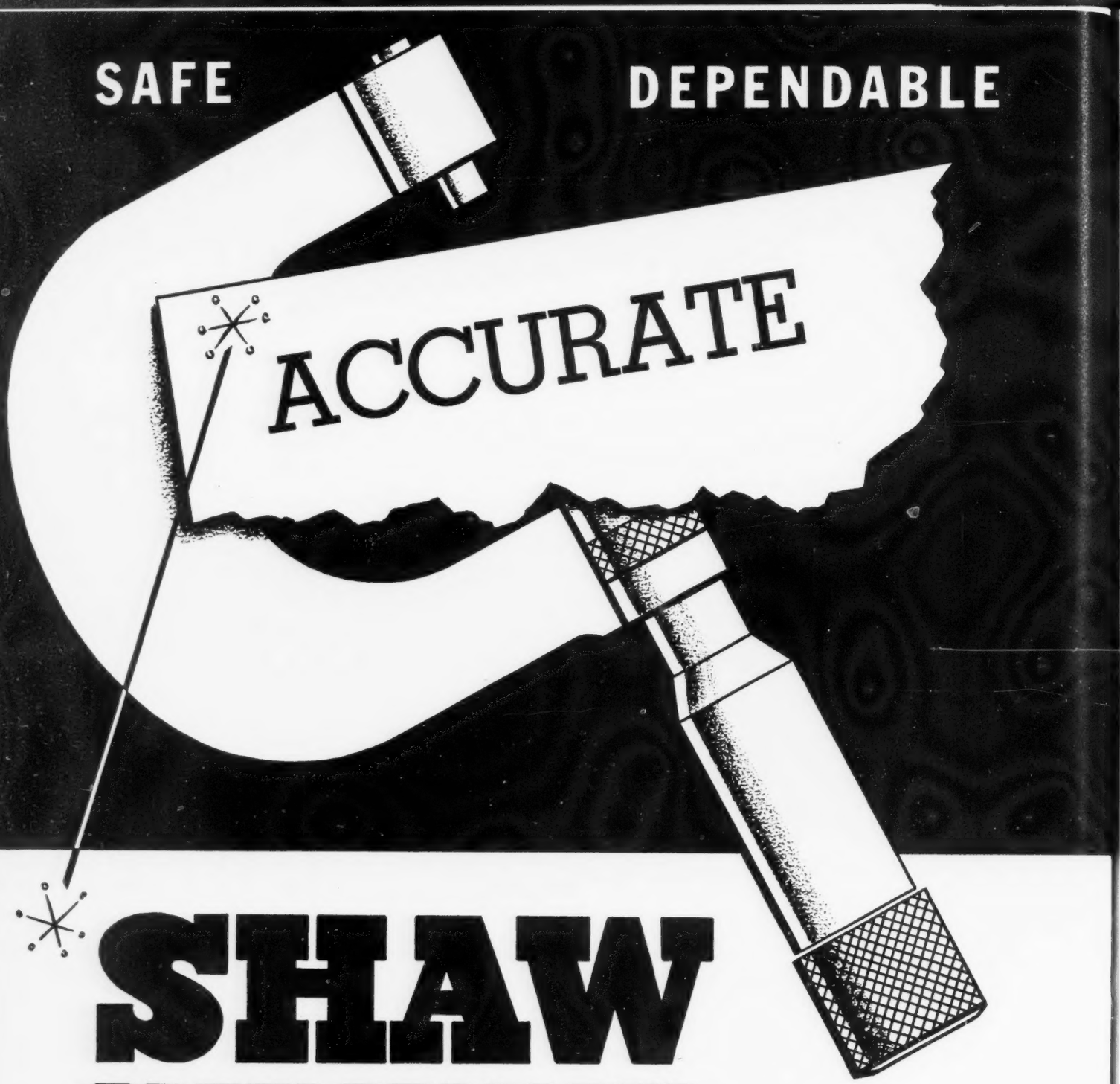
Bailey Meter Control is the Power Engineer's first lieutenant—always on duty to save fuel, protect equipment, and render reliable power service.

Ask for Bulletin No. 102-C which tells the full story of this complete Combustion Control System. A-70

BAILEY METER COMPANY
1036 IVANHOE RD., CLEVELAND, OHIO
Bailey Meter Company Limited, Montreal, Canada

The Complete Combustion Control System

CONTROL • DESUPERHEAT CONTROL • COMBUSTION CONTROL • FEED WATER CONTROL



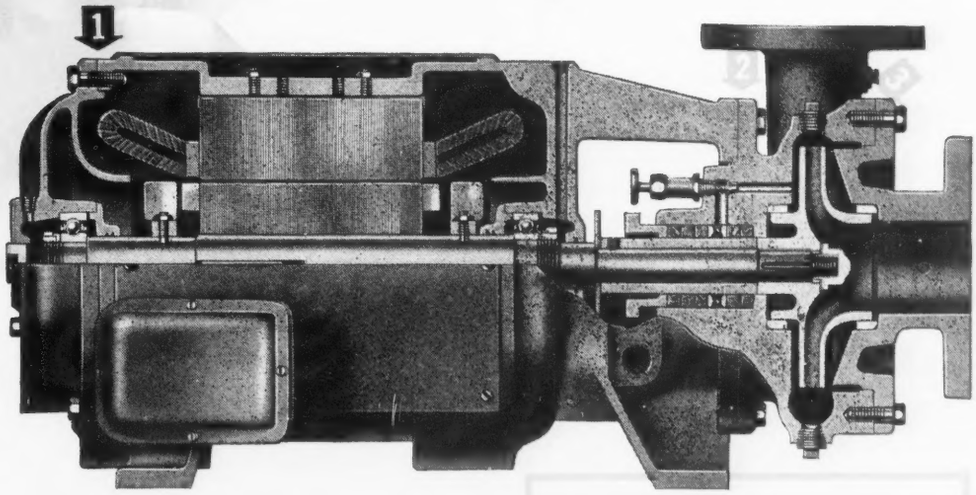
SHAW PREFABRICATED PIPING

The Benjamin F. Shaw Company's reputation for dependable prefabrication and careful erection of piping has been built through 49 years of specialization in this work. Geared for fast, low-cost production, we can meet your demands for every type of SAFE, DEPENDABLE, ACCURATE prefabricated piping. We invite your inquiry.

BENJ.F. SHAW COMPANY
SINCE 1893
WILMINGTON, DEL.

THREE SECTION-FITS

Make Engineering News!



Allis-Chalmers Electrifugal Pump Offers Exclusive "Tri-Fit" Design with One Piece Casting for Motor, Pump and Bearing Housing, Pump Bracket and Feet . . . Cuts Costs Up To 33%!

ANOTHER ENGINEERING SCOOP for Allis-Chalmers! A new, compact pump unit that offers you these outstanding improvements...

Unified "Tri-Fit" construction guarantees more positive alignment of the single shaft, less wear and tear . . . smoother running, vibration-free operation.

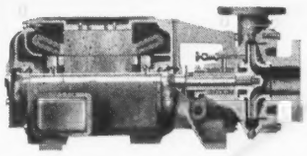
A new motor. . . 100% designed for pump drive and *completely splash-proof* . . . gives far more efficient power.

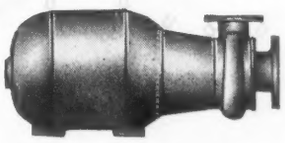
One-piece frame saves as much as 33% in space . . . 40% in overhang! Indestructible rotor and distortionless stator provide low maintenance and trouble-free service. Cast bronze protective sleeves, splash-proof ventilation and cast aluminum fans are other features that make this revolutionary pump such a great achievement in design and construction!

Best of all . . . *it cuts your costs up to 33% over conventional pump installations.*

For the money-saving details on this new "One Package" Pump . . . call the engineer in the district office near you. Or write Allis-Chalmers, Milwaukee, Wis. for Bulletin B-6140. A-1443

MAKE THIS 3 TO 5 TEST YOURSELF





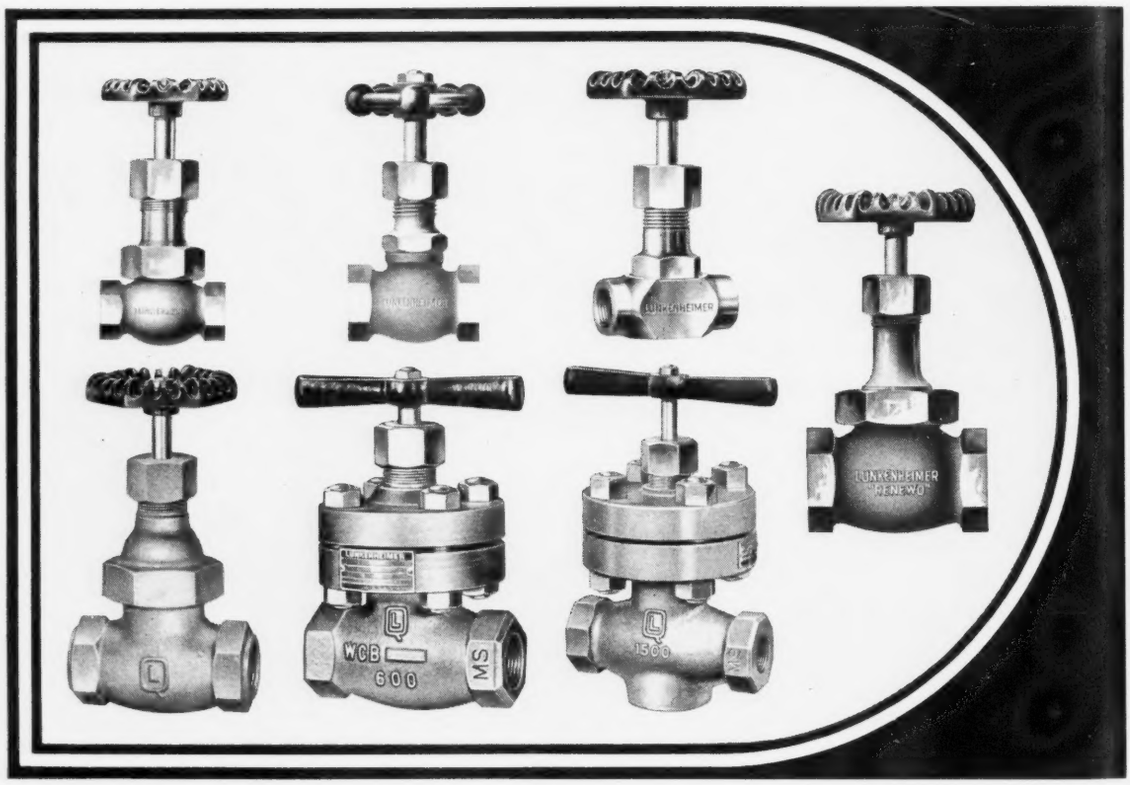
The NEW Allis-Chalmers Electrifugal Pump has only three section-fits to five or more for old style pumps! That means more perfect alignment of the shaft, less vibration —less wear—less trouble. Here's a pump that gives you more gallons . . . for less cost!

Allis-Chalmers Pumps Can Cut Your Pumping Costs

ALLIS-CHALMERS
MILWAUKEE · WISCONSIN

ACCURATE FLOW

means uninterrupted pro



CONTROL

duction from the assembly line.....

LUNKENHEIMER VALVES

Assure accurate-positive control

ESTABLISHED 1862

THE LUNKENHEIMER CO.

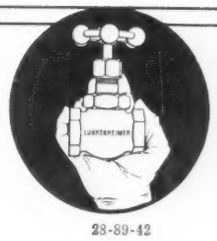
"QUALITY"

CINCINNATI, OHIO. U. S. A.

NEW YORK CHICAGO

BOSTON PHILADELPHIA

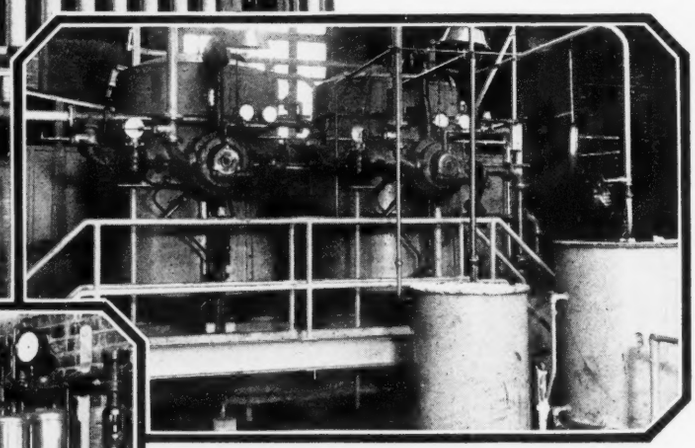
EXPORT DEPT. 318-322 HUDSON ST., NEW YORK

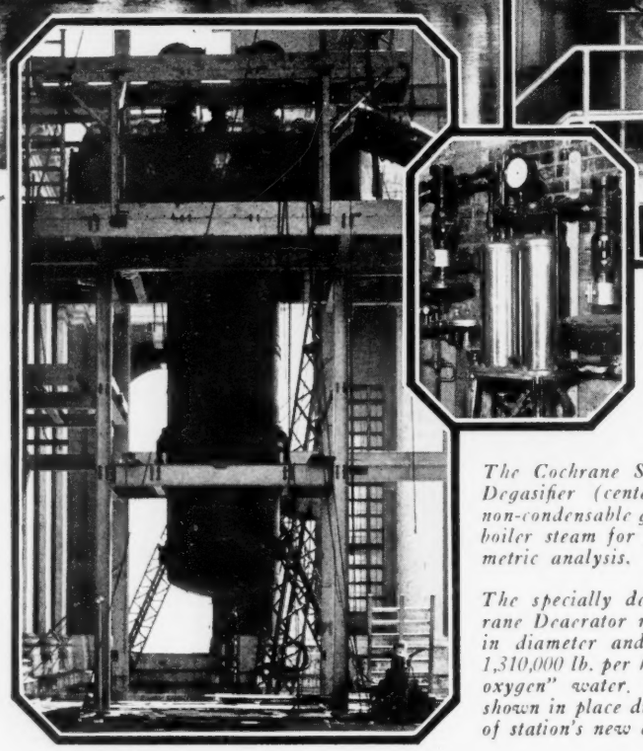


28-89-42

Water Conditioning at Chester STATION

PHILADELPHIA ELECTRIC COMPANY





Each of the Cochrane CARBITE Softeners (above) is equipped with a 3-inch single control valve. Note salt-storage and brine-measuring tanks in foreground.

The Cochrane Steam Sample Degasifier (center) separates non-condensable gases from the boiler steam for further gasometric analysis.

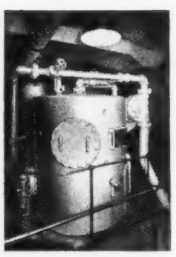
The specially designed Cochrane Deaerator measures 8 ft. in diameter and can deliver 1,310,000 lb. per hour of "zero-oxygen" water. Deaerator is shown in place during erection of station's new addition.

THE Cochrane Deaerator at Philadelphia Electric's Chester Station supplies "zero-oxygen" water to the high-pressure boilers for the new #5 and #6 turbines. The 25-ft.-high Deaerator storage tank is specially designed for variable pressure, operating in parallel with the existing constant pressure units. Variable water level in the Deaerator storage tank compensates for the changing Deaerator pressure and maintains proper head on the pumps supplying the high-pressure boilers through closed heaters and supplying low-pressure boilers at the same time.

Makeup to evaporators is supplied through a double-unit Cochrane CARBITE Zeolite Softener equipped with rotary-disc single control valves. Separate salt-storage and brine-measuring tanks are employed. Chester City water with 4 to 8 grains of hardness per gallon is treated by exchanging the hardness ions for sodium in the CARBITE beds. The two 5½-ft.-diameter softening units are each capable of softening 65,000 gallons of 8 grain water between regenerations.

COCHRANE CORPORATION • 3106 N. 17th ST. • PHILADELPHIA, PA.

COCHRANE PRODUCTION DIRECTLY FOR DEFENSE



Deaerators for U.S. Navy and U.S. Maritime Commission Ships . . . by Cochrane Corporation, long-time specialists in the conditioning of boiler feedwater. One of a growing list of power-plant equipments developed primarily for National Defense . . .

Cochrane

SOFTENERS • DEAERATORS • FLOW METERS • STEAM SPECIALTIES

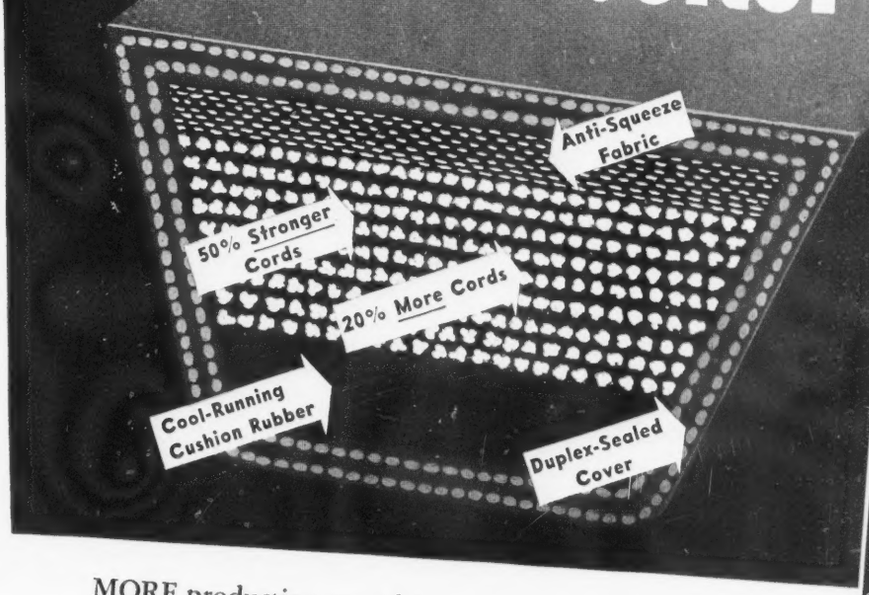
50% STRONGER CORDS
20% MORE CORDS
In Texrope* Super-7 V-belts!

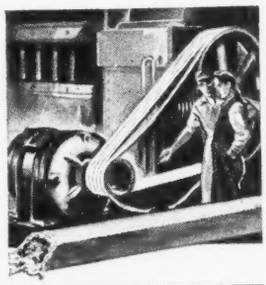
1 50% STRONGER CORDS! Sensational new Flexon process makes cords 50% stronger than even those in former great Texrope belts.

2 20% MORE CORDS! Count them! You get 20% more of these tough, extra pulling power cords in every Texrope Super-7.

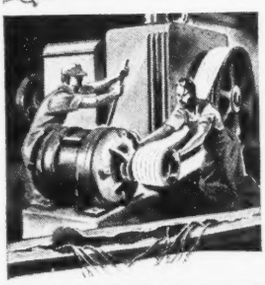
3 INCREASED LIFE! Cords float on amazing cool-running cushion rubber that absorbs shock . . . actually increases belt life phenomenally.

4 EXTRA PROTECTION! Exclusive duplex-sealed cover protects pulling cords against dirt, grit, moisture, and other adverse elements.

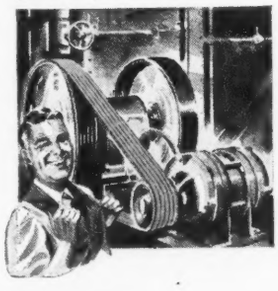




LOOK OUT FOR DANGER in belts with stiff, unpliable cords! Such belts *look* strong... but actually they buckle over sheaves, build up excessive heat that attacks pulling cords. Result: Belt failure far sooner than you expect it.



WARNING SIGN! Sagging, slipping belts mean too much stretch not backed up by balanced cord strength. Motor must be pulled back often to take up slack. Result: When stretch limit is reached belt breaks under tension.



SUPER-7 TEXROPE BELTS are made by amazing Flexon process that *combines* flexibility with low stretch... great strength. Cords float on cool-running, shock absorbing cushion rubber. Result: *true* strength . . . *true* pulling power . . . *true* endurance.

MORE production out of *present* equipment—that's the big need today. And that's what you get by changing over your power transmission to new Texrope Super-7 V-belt Drives!

For here's the newest V-belt line on the market—developed and built for modern high-speed production . . . to give you greater belt pulling strength and longer belt life . . . and add urgently needed efficiency to your machines.

You'll like these new belts — with 50% stronger "Flexonized" cords . . . 20% more cords . . . newly developed cool-running rubber cushion section to absorb operating shocks . . . "duplex-sealed" two-ply cover.

And you'll like their true V-shape for greatest groove-grip action . . . their silent, slipless operation.

So — do as hundreds of other hard-pressed companies are doing today. Use the new Super-7 V-belts to give increased production capacity to your present equipment.

Call your dealer or the Allis-Chalmers district office near you. Or write direct, asking for Bulletin B6190. A 1470

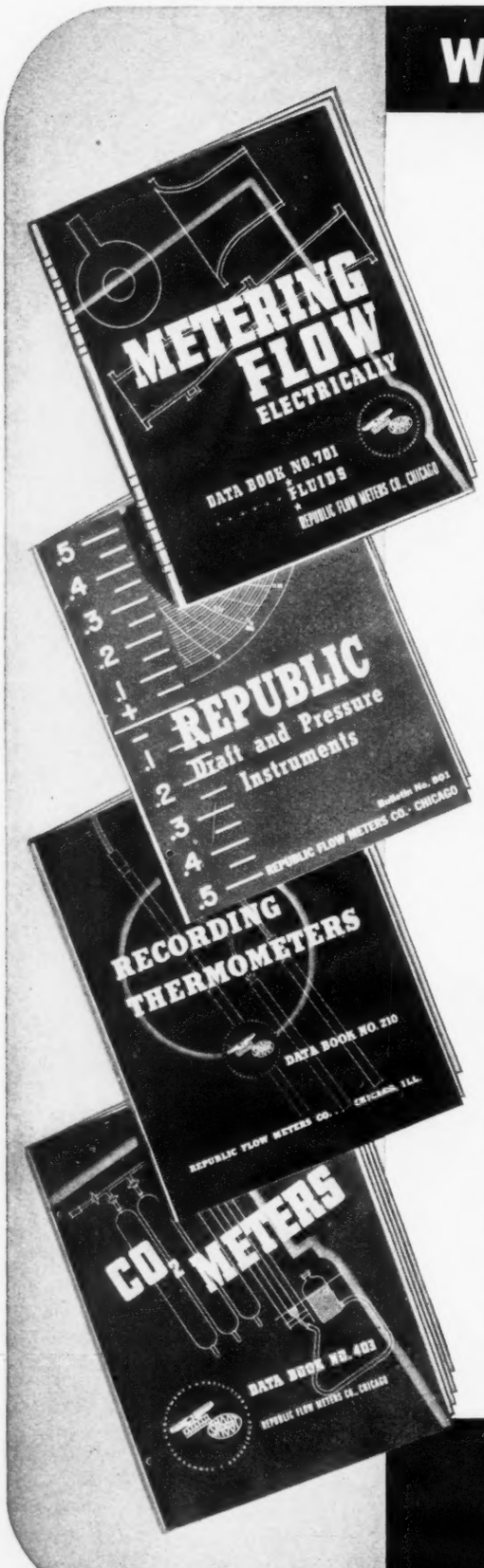
Available in All Sizes
½ hp to 2000 hp

ALLIS-CHALMERS
MILWAUKEE·WISCONSIN

*Trade mark registered U. S. Patent Office. Texrope Super-7 Belts are the result of the cooperative research and design genius of *two* great companies — Allis-Chalmers and B. F. Goodrich — and are sold exclusively by Allis-Chalmers.

These Data Books . . .

WILL HELP YOU SOLVE



● Write for these data books now! They are filled with important power plant data generally difficult to locate. When your increased power load demands the installation of new units or the "stretching" of existing plant capacity, you will need this information.

REMOTE READING FLOW METERS—Data Book No. 701
For measuring flow of steam generated by each boiler and the total produced; steam consumed by prime movers and process steam consuming units; water supplied to boilers and pumped to processes; rate of generation, distribution and consumption of natural gas, coke oven gas, compressed air and the like; flow of fuel oil, brine, black liquor and so on; the Republic electrical type flow meter with remote reading instruments, as described in this book, is available.

MECHANICAL FLOW METERS—Bulletin No. 110
When it is desired to measure flow of steam, water, gas, air or oil for the same purposes as outlined above but where remote registration is not required, the Republic mechanical ring-balance meter described in this book is available. Since it may be built for differentials as low as 3 in. of water, it is ideal for low-pressure gas and air.

DRAFT AND PRESSURE INSTRUMENTS—Bulletin No. 801
Proper regulation of draft is one of the most important requirements in obtaining highest combustion efficiency. For indicating and recording drafts, pressures and differentials, Republic indicators and recorders, described in detail in this bulletin, are supplied in any desired combination for all ranges encountered in furnace operation.

RECORDING THERMOMETERS—Data Book No. 210
Measurements of temperature of flue gas, temperatures in vats or tanks, pipe lines, refrigeration systems, ovens, kilns or ducts and so on, are vital in maintaining highest capacity and efficiency in power plant and process equipment. Republic recording thermometers for this service are described in this data book.

CO_2 METERS—Data Book No. 403
For every fuel and boiler, there is a definite percentage of CO_2 in the flue gas that will assure highest combustion efficiency. The CO_2 meter is the most practical method of determining combustion efficiency. The construction and operation of the Republic CO_2 meter are described in detail in this book.

Do you have these data books?
If not, write for them today.

YOUR POWER PROBLEMS

REGULATORS—Data Book No. S-13

Control of rate of flow of liquids and gases, level of liquids, speed of turbines, engines and motors and proportions between variable pressures and flows must be accurate if maximum plant efficiency is to be attained. These factors are controlled by operation of valves, dampers, rheostats, etc. For sensitive, fast, stable and powerful automatic control of these devices, the Republic-Smoot regulator has been developed. Its construction, operation and applications are described in this book.

AUTOMATIC COMBUSTION CONTROLS—Data Book No. S-21

Boilers must produce maximum steam output at maximum efficiency. That means constant steam pressure, maximum combustion efficiency, constant and correct furnace draft, desired load division among boilers. Republic-Smoot automatic combustion control systems are built for all sizes of boilers, all types of fuel firing and all load conditions, as described in this book, which includes detailed installation reports giving performance data on outstanding power plants.

REGULATING VALVES—Bulletin No. S-40

In any plant generating high-pressure, high-temperature steam, there are key valves doing tough jobs in controlling flows or pressures on which vital operations depend — pressure reducing valves co-ordinating high and low pressure steam systems, feedwater valves on 1500 lb. boilers. For such tough jobs, where responsibility, long life and accurate regulation count most and failure must not occur, the Republic-Smoot valves described in this bulletin have been designed.

DESUPERHEATERS—Data Book No. S-35

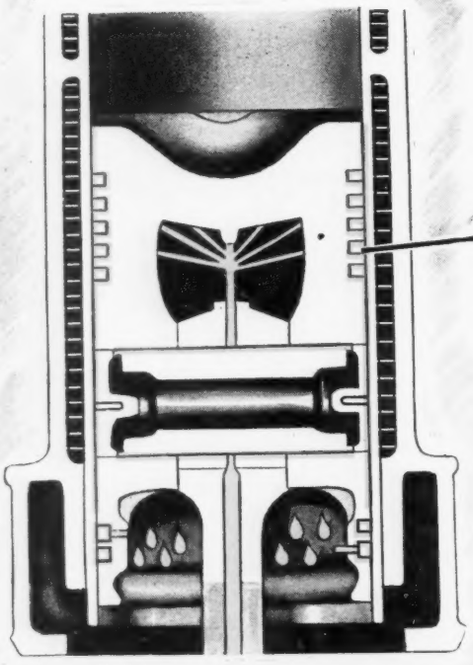
In the modern power plant, steam temperatures in interconnected systems — topping turbine bypasses, tie lines, turbine exhaust lines and process steam headers — must be accurately controlled by desuperheaters. For such exacting services, the Republic-Smoot desuperheaters described in this book are employed.

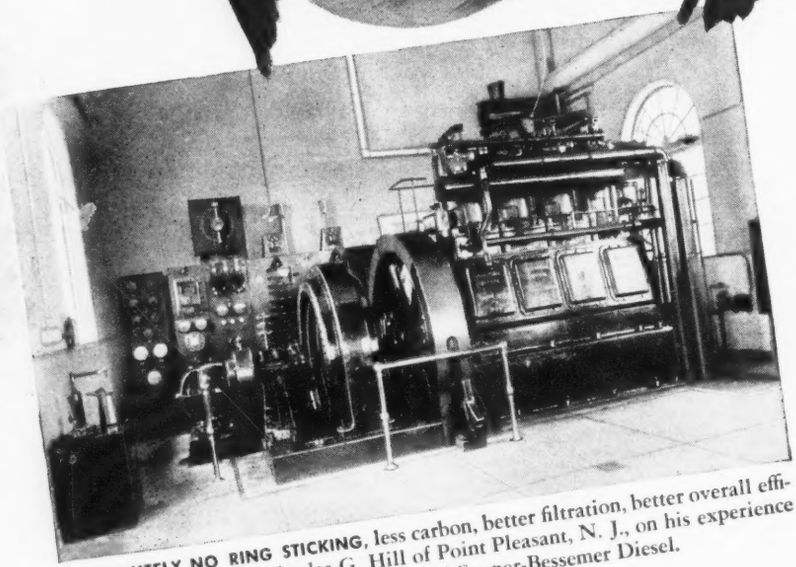
The Republic Flow Meters Co. offers a complete manufacturing and engineering service in the field of measurement and control. We will be glad to co-operate with you in the solution of any metering or control problem, whether it involves a single instrument or the automatic control of an entire process or plant. Your inquiries will involve no obligation on your part.

REPUBLIC FLOW METERS CO.

2222 DIVERSEY PKWY., CHICAGO, ILL.

The Seal that points





"ABSOLUTELY NO RING STICKING, less carbon, better filtration, better overall efficiency . . ." says Mr. Charles G. Hill of Point Pleasant, N. J., on his experience with *Texaco Ursa Oil* in this 12½" x 18" Cooper-Bessemer Diesel.

TEXACO

REG. T.M.

TEXACO

to Full Power

YOUR DIESEL PISTON RINGS stay free in their grooves . . . continuously assuring compression seal that means full power output and maximum fuel economy . . . when you use *Texaco Algol or Ursa Oils.*

Highly resistant to the formation of gum, sludge and hard carbon, *Texaco Algol and Ursa Oils* keep rings, ring grooves, valves and ports CLEAN. The little carbon that may form is soft and fluffy . . . blows away with the exhaust.

Because of the benefits secured by users everywhere—

More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.

The outstanding performance that has made Texaco FIRST in the stationary Diesel field, has made it FIRST also in the fields listed in the panel.

These Texaco users enjoy many benefits that can also be yours. A Texaco Lubrication Engineer will gladly cooperate . . . just phone the nearest of more than 2300 Texaco distribution points in the 48 States, or write: The Texas Company, 135 East 42nd St., New York.

THEY PREFER TEXACO

- More locomotives and cars in the U. S. are lubricated with Texaco than with any other brand.
- More revenue airline miles in the U. S. are flown with Texaco than with any other brand.
- More buses, more bus lines and more bus-miles are lubricated with Texaco than with any other brand.
- More stationary Diesel horsepower in the U. S. is lubricated with Texaco than with any other brand.
- More Diesel horsepower on streamlined trains in the U. S. is lubricated with Texaco than with all other brands combined.

NEW EDITION . . . Texaco's Diesel Operation Manual. 96 pages of charts, diagrams, photographs and text, plus new section on special purpose Diesel lubricants and complete Diesel lubrication chart. Yours for the asking.

FOR YOUR ENJOYMENT • Two Great Radio Programs

FRED ALLEN every Wednesday night. See your local newspaper for time and station.

METROPOLITAN OPERA. Complete broadcasts of great operas every Saturday. See your local newspaper for time and station.

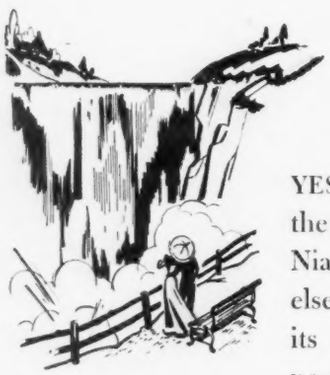
RETURN METAL DRUMS PROMPTLY . . . thus helping to make present supply meet industry's needs and releasing metal for National Defense.

Lubricants and Fuels

FOR POWER PLANT EQUIPMENT

and so...

The Bride Wore *Black*



YES, FOR MANY YEARS, the thrill of a train trip to Niagara Falls or anywhere else for that matter, had its dark side. Railroad passengers could either open the windows and risk a shower of dirt and cinders—or close the windows and endure a hot, stuffy trip.

And, unfortunately, most people assumed that nothing could be done about it. Sturtevant engineers, however, went to work on this problem—developed and built the pioneer railway air conditioning system. For the first time clean, cool air was available for railway passengers at the turn of a switch.

That was in 1910—years ahead of its time. With the growth of public interest in air conditioned theatres and restaurants, however, attention was turned again to the opportunities for air conditioned trains. Sturtevant had the answer.

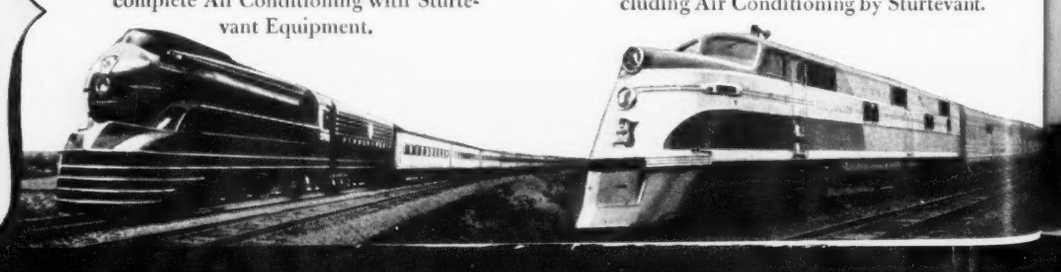
Today, the vision of those men who foresaw the time when air conditioning would revolutionize railway travel has been realized. More than 8,500 cars on 40 railroads are equipped with Sturtevant Air Conditioning Systems or Apparatus.

And in countless other ways, Sturtevant "Puts Air to Work" for American and Cana-

Sturtevant
Puts Air to Work
for
the Railroads

Broadway Limited—
Pennsylvania Railroad's 16 hour, New York to Chicago flyer features such travel luxuries as Barber and Maid Service, Bedrooms, Duplex Rooms—and complete Air Conditioning with Sturtevant Equipment.

Rocket—
One of 15 streamliners of Chicago, Rock Island and Pacific Railroad serving the Middle West and incorporating every known improvement in rail travel—including Air Conditioning by Sturtevant.



dian Railways . . . ventilating Tunnels, heating draft-swept Round Houses, cooling Diesel Engines and Traction Motors, fanning the flames of Power House Boilers.

B. F. STURTEVANT COMPANY

Hyde Park, Boston, Mass. *Branches in 40 Cities*

B. F. Sturtevant Company of Canada, Ltd., Galt, Toronto, Montreal

Sturtevant

REG. U. S. PAT. OFF

Puts Air to Work

STURTEVANT — FOUNDER OF THE AIR HANDLING INDUSTRY

20th Century—

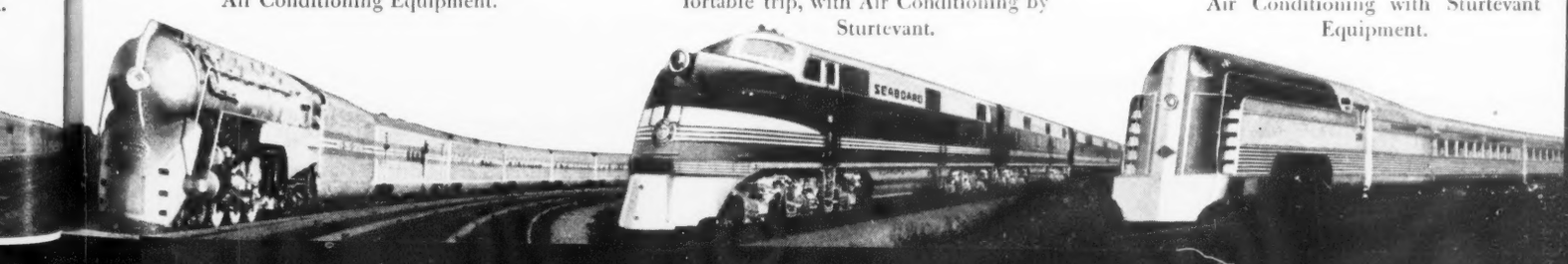
The most famous train in New York Central's crack New York to Chicago fleet, provides the utmost in safety, speed —and comfort provided by Sturtevant Air Conditioning Equipment.

Silver Meteor—

and the Orange Blossom, diesel-powered streamliners cut more than two hours from New York to Florida run of the Seaboard Railway—assure a cool, comfortable trip, with Air Conditioning by Sturtevant.

Crusader—

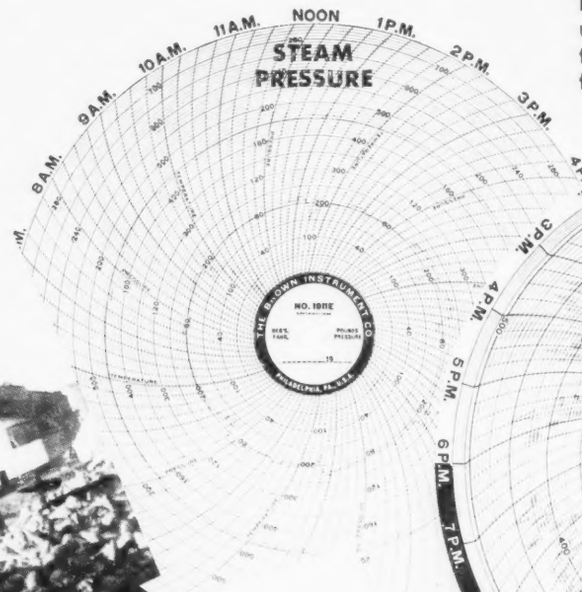
Reading Railway's new Philadelphia to New York Streamliner provides every up-to-the-minute comfort, at coach fares . . . including complete Air Conditioning with Sturtevant Equipment.



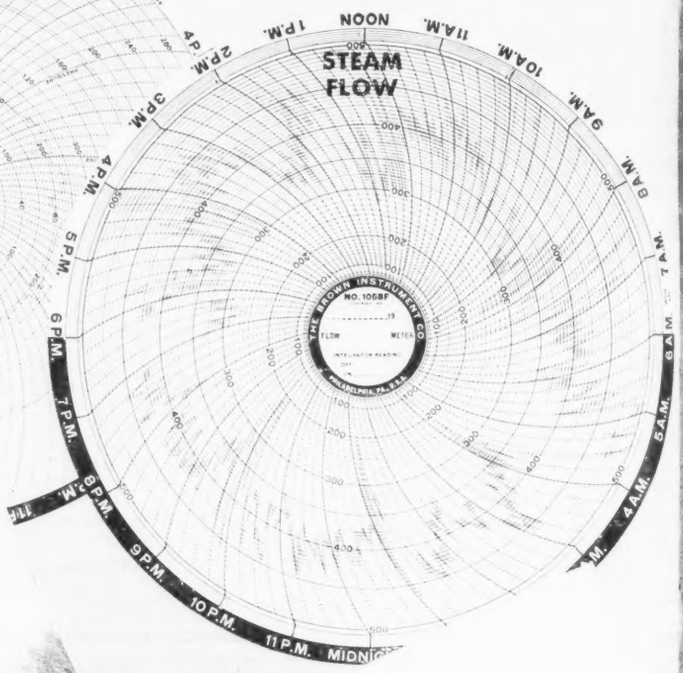
DO A SWEET JOB FOR MICHIGAN SUGAR COMPANY

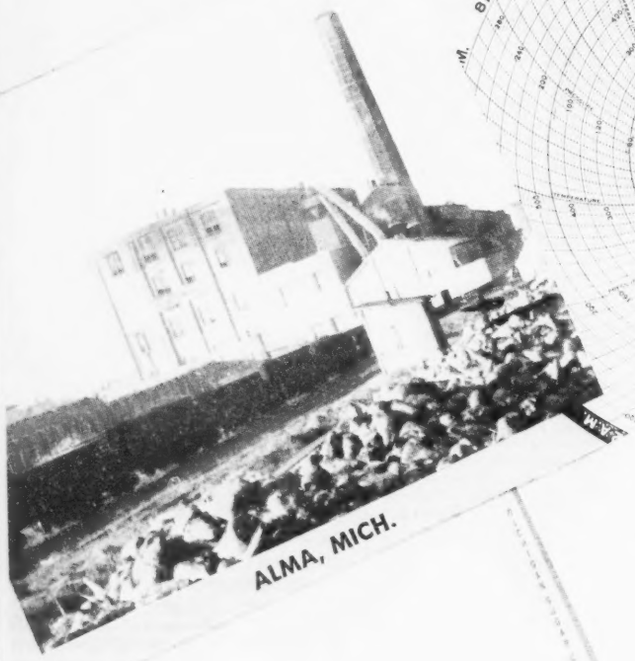
Dependable Steam Supply is of paramount importance in the production of fine sugar from sugar beets. Heavy steam loads—Twenty-four hours a day. Steam Generating equipment must not fail.

MICHIGAN SUGAR COMPANY uses nineteen DETROIT STOKERS —Total capacity over 800,000 pounds of steam per hour, IN SIX PLANTS.



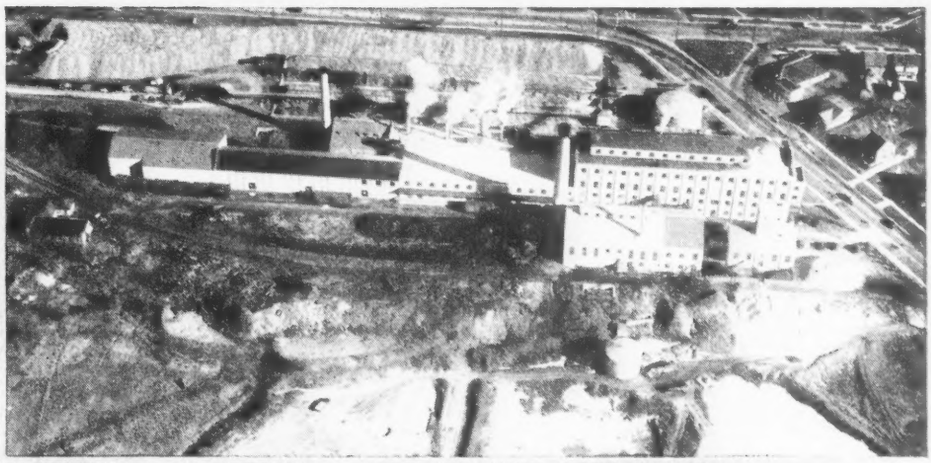
Note — Detroit Stokers maintain uniform steam pressure with extremely fluctuating load. Charts from Croswell, Michigan Plant.



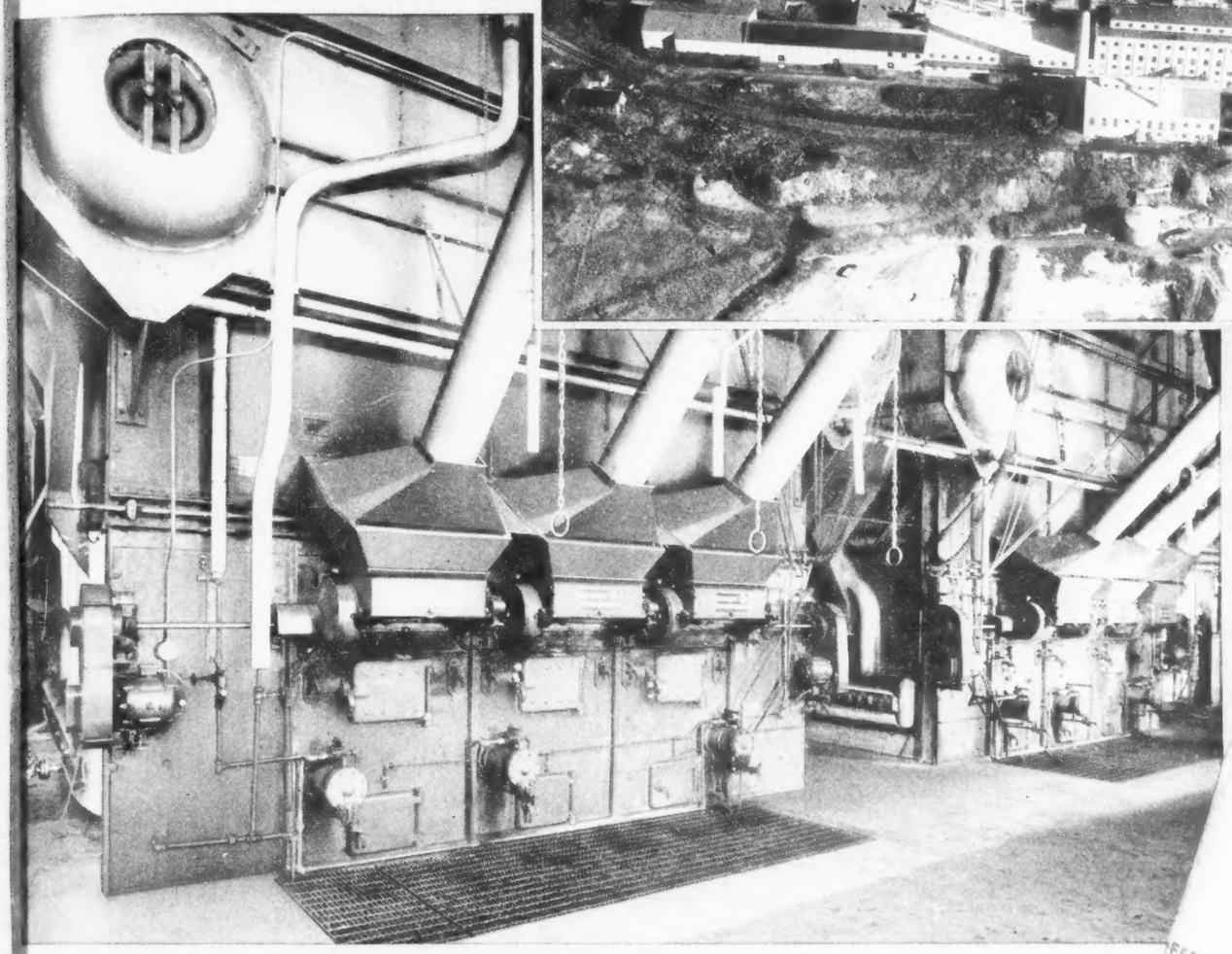

ALMA, MICH.

SAGINAW, MICH.

CROSWELL, MICH.



LANSING, MICH.



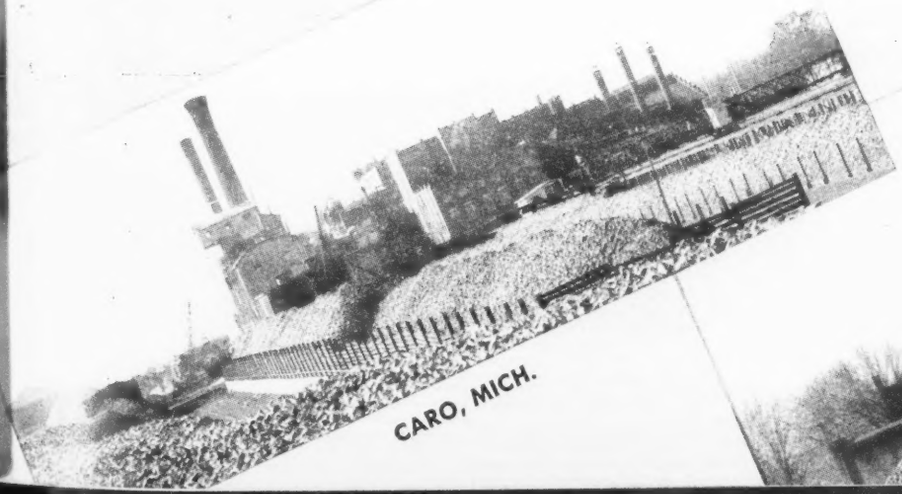
Detroit Stokers at Lansing, Mich. Total 160,000 pounds of steam per hour.

SEND FOR BULLETIN 530

DETROIT STOKER COMPANY

Sales and Engineering Offices,
General Motors Bldg., Detroit

Main Office and Works, Monroe, Mich.
Built in Canada at London, Ontario



CARO, MICH.

SEBEWAING, MICH.

"We Held Our Conference in the Power House!"

"POWER was the bottleneck in our plant as defense orders began to pile up. So we held our conference in the power house . . .

"We knew the only way to meet delivery dates was to use every piece of power-making equipment we had . . . get full capacity . . . without shutdowns or unscheduled outages of any kind.

"Our power plant superintendent told us there was only one answer — a feedwater service that would completely protect our power plant equipment month in and month out against scale, corrosion, carryover, and embrittlement!

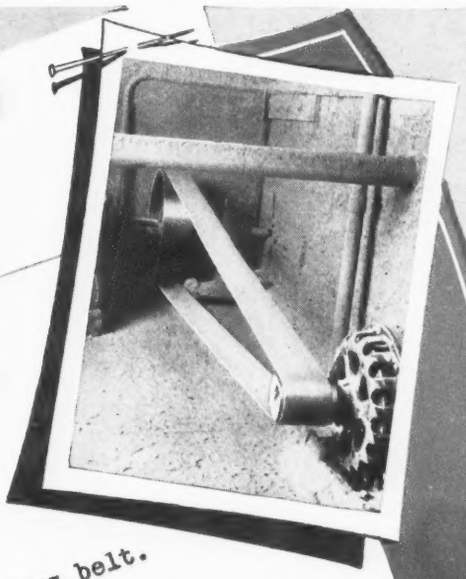
"That's why we are using the Allis-Chalmers Feedwater Service. And take it from us — here's a service that really does a job. The Allis-Chalmers feedwater service men come into the plant, keep in constant touch with conditions, make sure the feedwater is correct at all times."

IT WILL PAY YOU, too, to find out about the Allis-Chalmers Feedwater Treatment Service, based on over 60 years' experience in manufacturing power plant equipment and 15 years providing feedwater service. A trained Allis-Chalmers feedwater engineer is available to you — for consultation or service — upon your request.

A-1463

ALLIS-CHALMERS
MILWAUKEE · WISCONSIN

A hard grind



PROBLEM: Line shaft drive, runs elevator leg and other machinery in feed grinding mill. Conventional "double" belts broke after about 11 or 12 months' service.

OPERATING CONDITIONS: Severe dust

G.T.M. RECOMMENDATION: Goodyear Compass "40," truly endless belt.

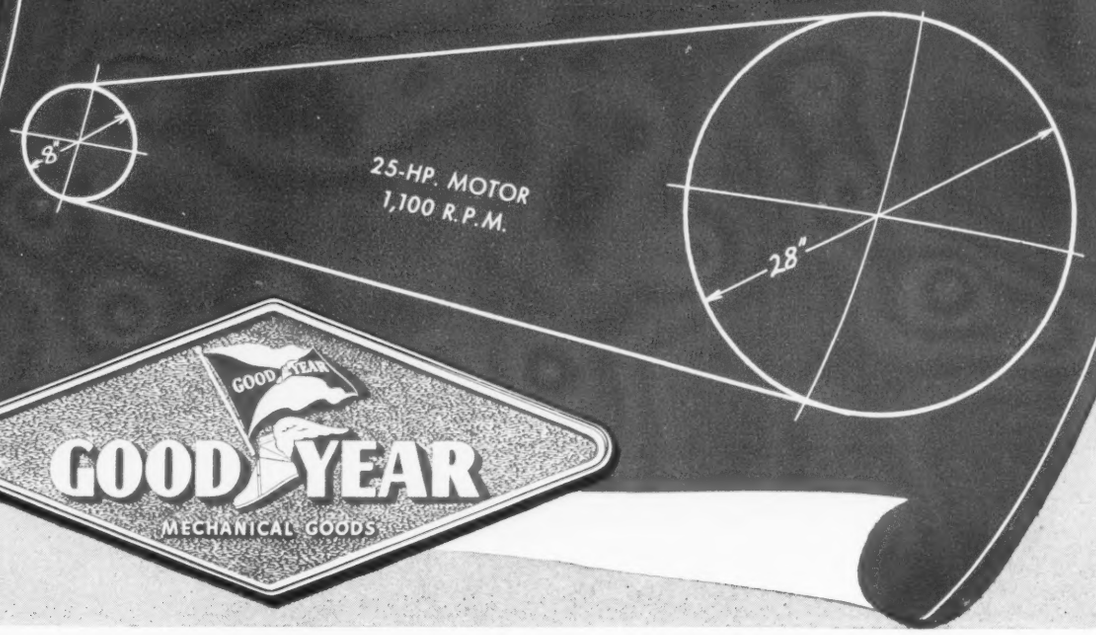
RESULT: Compass still in service after four years--- 4 to 1 more durable than previous belts. Still in excellent condition.

REMARKS: Plant now using Goodyear belts exclusively. Customer "more than pleased."

TO CONSULT THE GOODYEAR TECHNICAL MAN, write Goodyear, Akron, Ohio or Los Angeles, California—or phone the nearest Goodyear Mechanical Rubber Goods Distributor.

Compass—T.M. The Goodyear Tire & Rubber Company

GTM-Specified
GOODYEAR COMPASS "40" BELT
28'6" long x 8" wide
for LINE SHAFT DRIVE
in FEED GRINDING MILL



GOODYEAR
MECHANICAL GOODS

HAVE YOUR BOILERS EQUIPPED WITH ERNST "SPLIT-GLAND"

ADJUSTABLE WATER GAGES

They can be attached to any make of water column or boiler

FOR ALL PRESSURES

GAGES CAN BE SET AT ANY ANGLE OR VERTICAL

NO GAGE GLASS PACKING NUTS

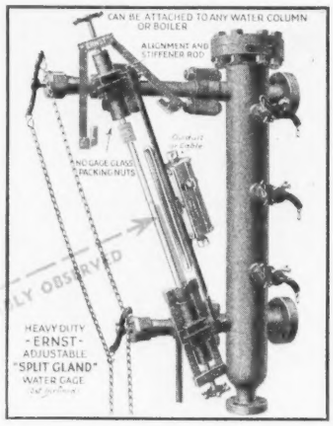
No Tools Required to Change A Gage Glass

WATER LEVEL VISIBLE FROM BELOW

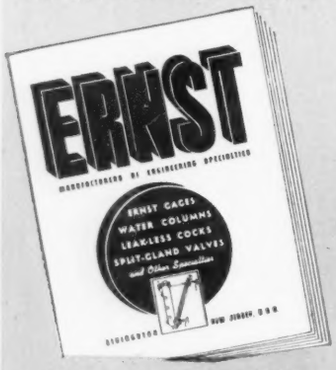
MOST IMPORTANT of the boiler attachments is THE WATER GAGE

For steam pressures above 500 lbs. we recommend ERNST Flat Gage Glass Inserts with "SPLIT-GLAND" GAGES.

The Ernst improved Illuminator gives a bright reflection of the water. (No special red line glasses required.) No hoods or other complicated devices. Nothing to get out of order.


CAN BE ATTACHED TO ANY WATER COLUMN OR BOILER
ALIGNMENT AND STIFFENER ROD
NO GAGE GLASS PACKING NUTS
HEAVY DUTY -ERNST- ADJUSTABLE "SPLIT GLAND" WATER GAGE

ASK FOR BOILER CATALOG NO. 45-P



Mirror-Site

For Safety "Better-C" the ORIGINAL Water Level Ernst

How to specify "SPLIT-GLAND" *Column for your next project*

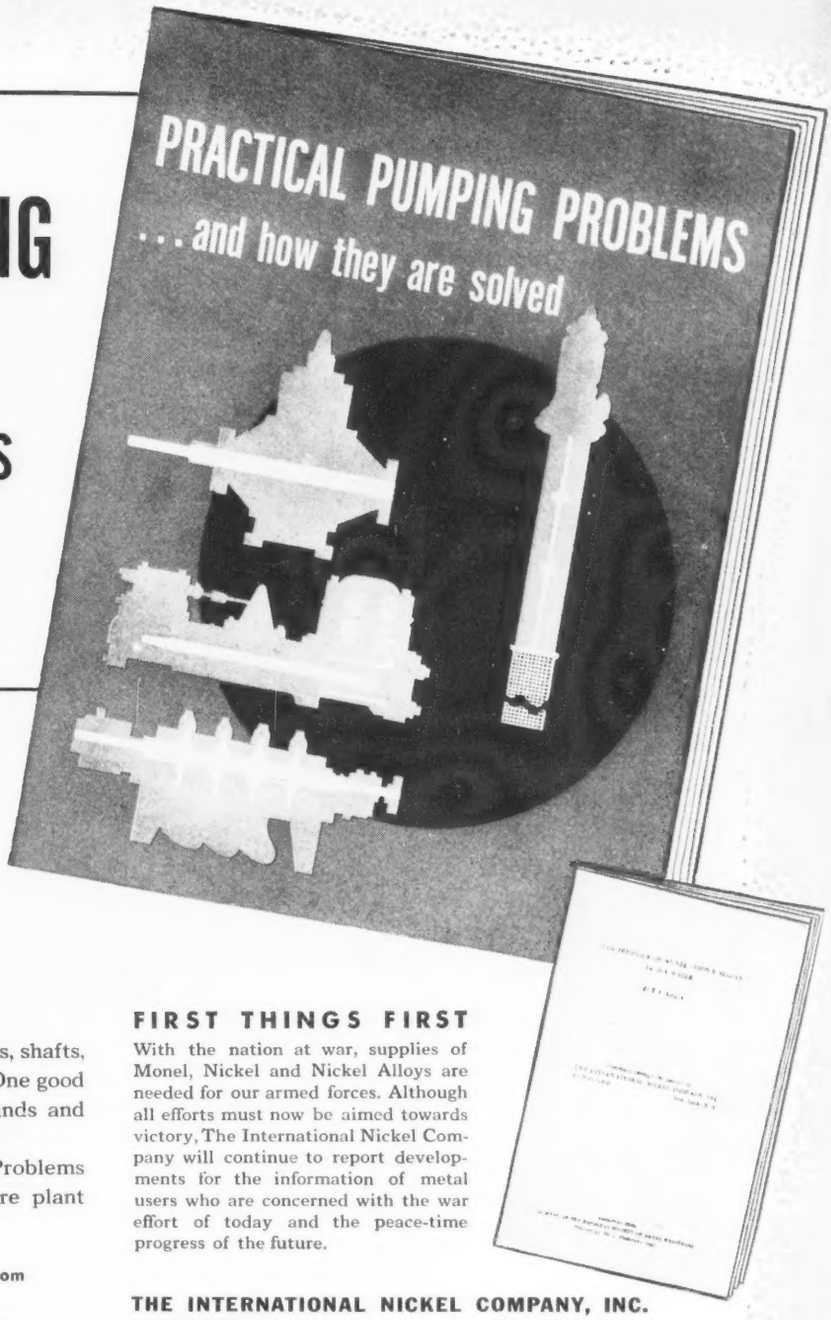
Each boiler to be equipped with Ernst Water Columns suitable for ..... pounds working pressure and each Column to be furnished with Split-Gland Adjustable Water Gage Fittings and Leakless Super Try Cocks. Gage Glass Guards and C-Red Illuminators are to be furnished, and sufficient rust-proof chain to operate Gages and Try Cocks from boiler room floor.

All material as manufactured by Ernst Water Column & Gage Co., Livingston, N. J.

ERNST WATER COLUMN & GAGE CO., LIVINGSTON, NEW JERSEY

COST-CUTTING IDEAS

for users of PUMPS



New Booklet recounts actual experience of power plant engineers

When you run into trouble with pump rods, shafts, sleeves, or valves, how do you correct it? One good way, that ends frequent repacking of glands and replacement of parts, is to use Monel.

For example: In "Practical Pumping Problems and how they are solved" ship and shore plant engineers give tips on the following:

- **How to get 5 to 50 times longer service from vital parts**
- **How to reduce power, packing, and maintenance costs**
- **General information on pumps by associate editors of "Power"**
- **Successful methods that solved difficult pump problems**
- **How to select materials for handling corrosives**

These improvements all result from use of Monel*, or its heat-treatable forms of "K" Monel* and "S" Monel*. Lastingly resistant to corrosion, these strong, tough alloys eliminate chances of breakdown, reduce repairs and maintenance, and thus help speed the arming of our forces.

MONEL

*"Monel" and other trade-marks which have an asterisk associated with them are trade-marks of the International Nickel Company, Inc.

FIRST THINGS FIRST

With the nation at war, supplies of Monel, Nickel and Nickel Alloys are needed for our armed forces. Although all efforts must now be aimed towards victory, The International Nickel Company will continue to report developments for the information of metal users who are concerned with the war effort of today and the peace-time progress of the future.

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street **New York, N. Y.**

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street, New York, N. Y.

Gentlemen:

Please send me without charge.....copies of the booklet checked:

- ☐ "Practical Pumping Problems and how they are solved."
- ☐ "List B" of available Bulletins and Instructions.

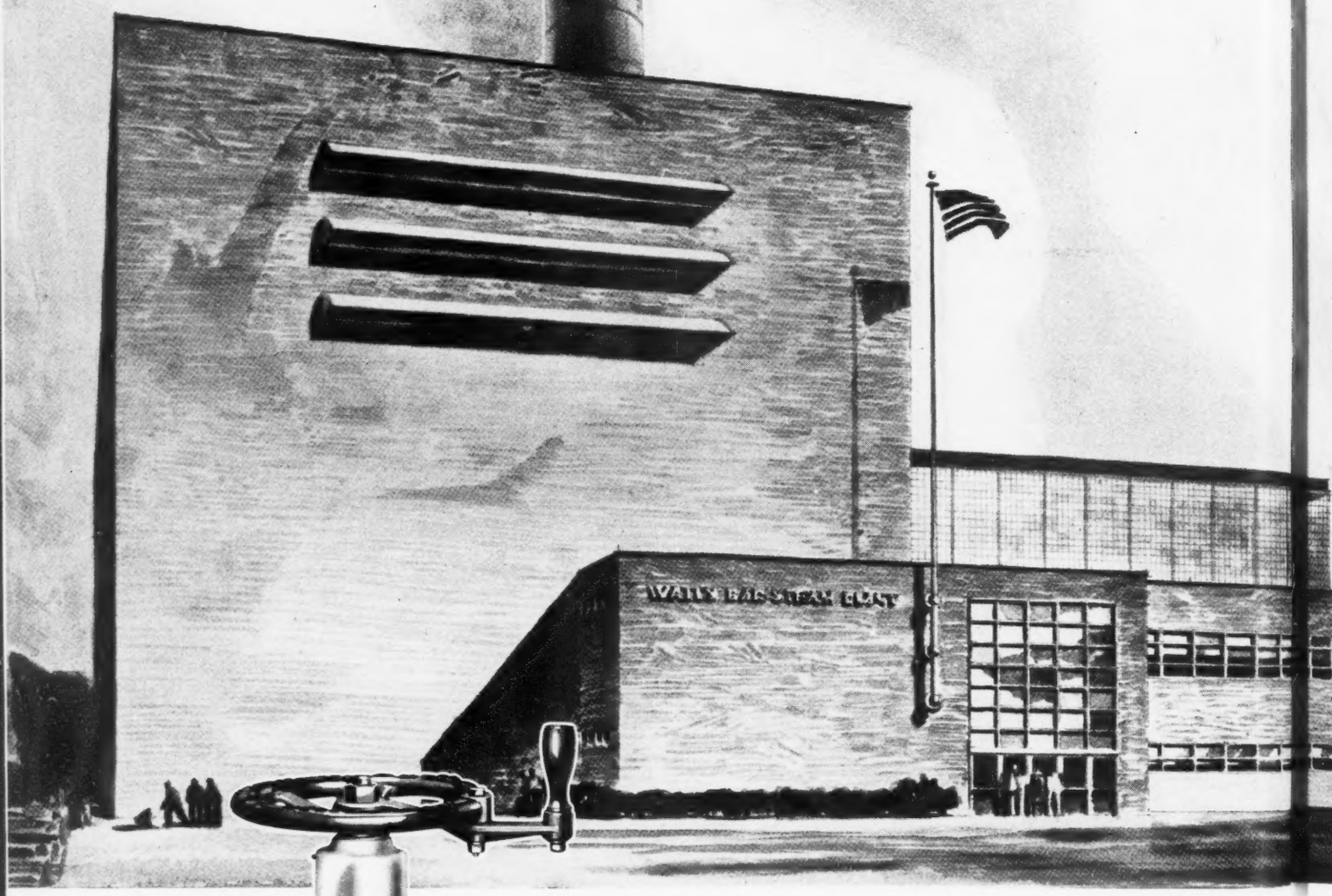
NAME TITLE

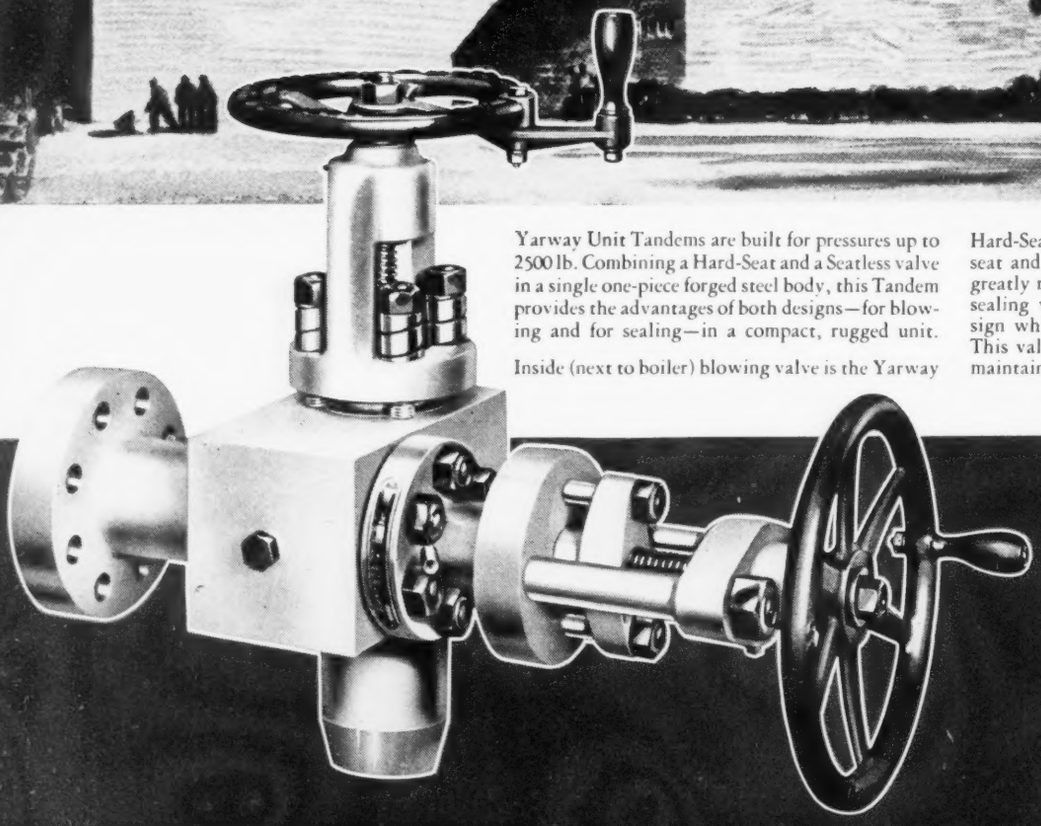
COMPANY

ADDRESS P 1-42

YARWAY

Watts Bar Steam Plant of the Tennessee Valley Authority, Spring City, Tennessee, supplements hydro-generated power to serve growing industry in the Southeast.





Yarway Unit Tandems are built for pressures up to 2500 lb. Combining a Hard-Seat and a Seatless valve in a single one-piece forged steel body, this Tandem provides the advantages of both designs—for blowing and for sealing—in a compact, rugged unit.

Inside (next to boiler) blowing valve is the Yarway Hard-Seat Valve which utilizes special Stellited seat and disc and unique construction features to greatly reduce wear in this type of valve. Outside sealing valve is the famous Yarway Seatless design which has no seat to score, wear and leak. This valve is always opened first and closed last, maintaining a tight seal.

at Watts Bar

TVA's amazing accomplishment in completing the first 120,000-KW section of the Watts Bar Steam Plant in eighteen months (ready to go on the line February, 1942) was possible through the use of simplified design and proved equipment which speeded construction and reduced preliminary operation to a minimum.

This 850-lb, 900 deg. F. steam plant, built to supplement hydro-generated power, will ultimately consist of four units when the last one goes into operation in October, 1942. All these boilers will be completely equipped with Yarway Unit Tandem Valves, equally suitable for blowing or draining—the dependable valve for high pressure service—the valve that has made such records as—"3000 blows at more than 1300 lb pressure, without replacement of a single part or repairs of any nature"—in the plants of leading utilities and industries.

There is a Yarway Blow-Off Valve for every pressure, purse and purpose. Write for Catalog; section B-421 for pressures up to 400 lb, section B-430 for pressures up to 2500 lb.

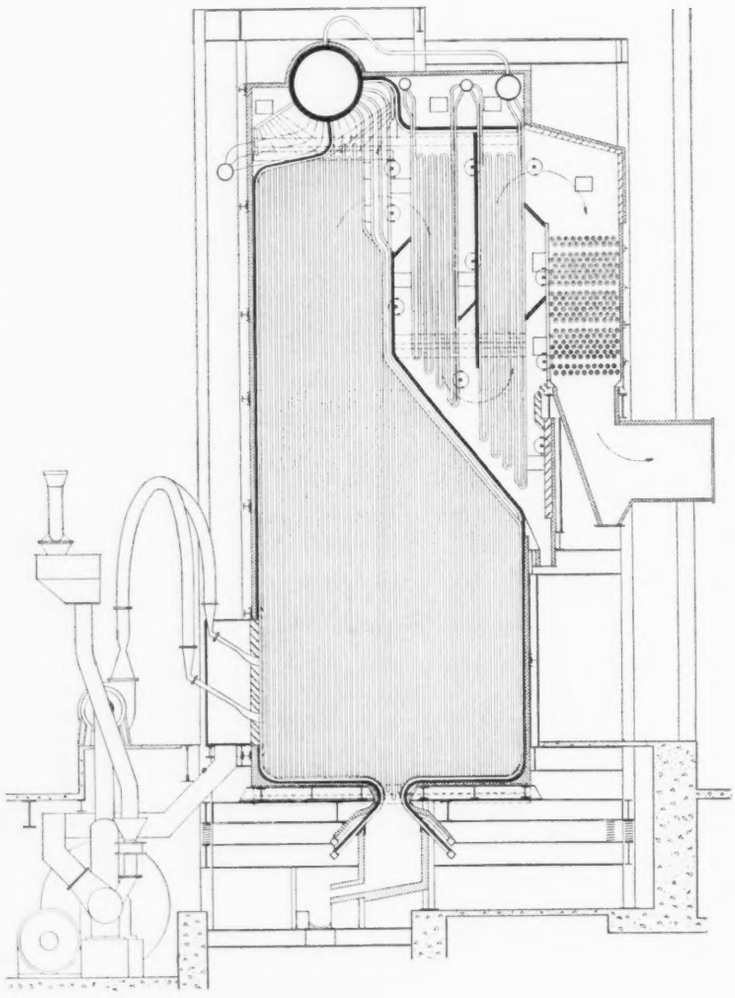
YARNALL-WARING COMPANY
100 Mermaid Ave. Philadelphia

YARWAY
BLOW-OFF VALVES

Two New Steam

COLUMBUS and SOUTHERN

The United Light & Power



WALNUT STREET STATION

Maximum Load

325,000 lb. per hour

1400 lb. per sq. in. pressure

900° F. final steam temp.

396° F. feedwater

85.11 efficiency

One Pulverizer

Noteworthy features of this installation are the design and construction of Foster Wheeler slagging furnaces and the FW Hardinge type ball mills.

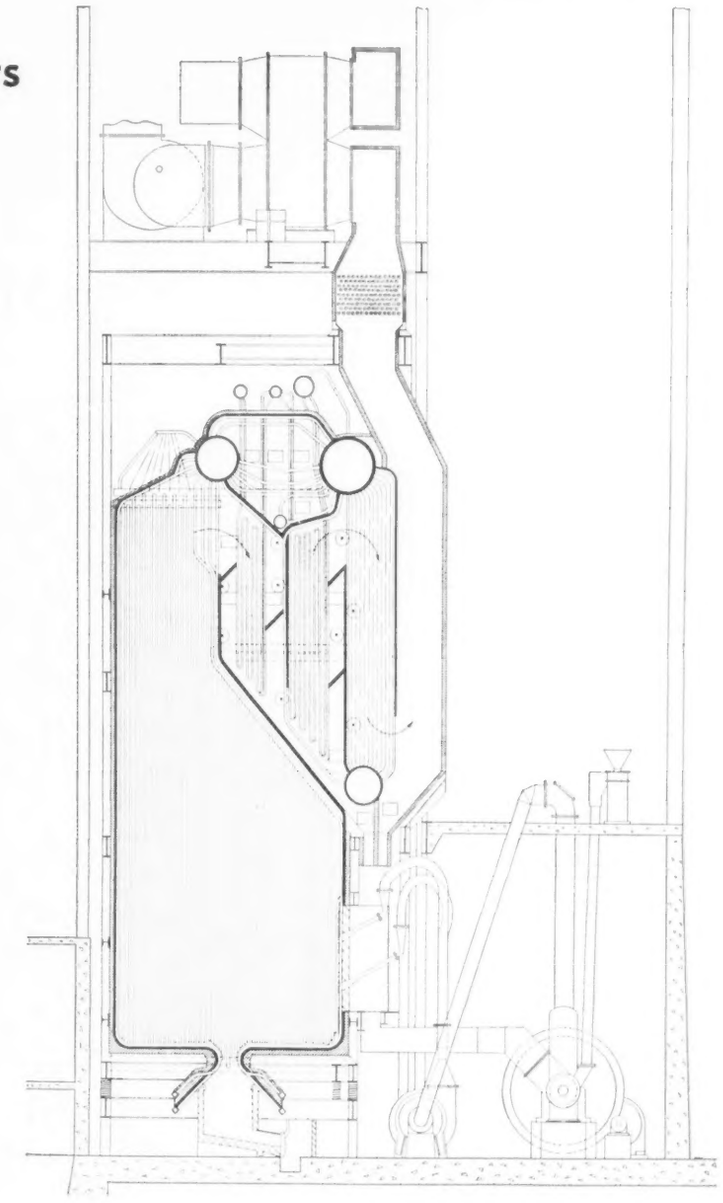
Foster Wheeler Corporation,

FW FOSTER

Generators For

OHIO ELECTRIC COMPANY

Service Company—Engineers



PICWAY STATION

Maximum Load

375,000 lb. per hour
900 lb. per sq. in. pressure
900° F. final steam temp.
400° F. feedwater
85.18 efficiency

One Pulverizer

High pulverizer availability records of Foster Wheeler ball mills resulted in the installation of a single pulverizer per boiler.

165 Broadway, New York

WHEELER

IT TOOK TWO ATTEMPTS . . .

. . . To Acquire the Right Steam Generating Equipment

HOW THE APPEAL OF A MORE ATTRACTIVE PRICE POSTPONED THE BEST SOLUTION OF THIS PLANT'S STEAM GENERATING PROBLEM

"Why pay more than we have to for this new equipment?" was the opinion that influenced a large eastern brewery when considering new boiler plant facilities several years ago. As a result, they turned down a C-E proposal that frankly was more expensive but was based on a careful study of steam demand, available fuels and other conditions in the plant. Instead, the customer decided in favor of an installation commended by a material saving that would have proved well worthwhile . . . were initial price the only consideration in the selection of economical steam generating equipment.

As is so frequently the sequel to such a buying decision, a brief period of service quickly changed the customer's viewpoint. Efficiency fell below expectations and maintenance was higher than anticipated. These differences materially affected the picture of return on investment and served to emphasize the true economic measure of steam generating equipment — overall costs of year-in and year-out operation.

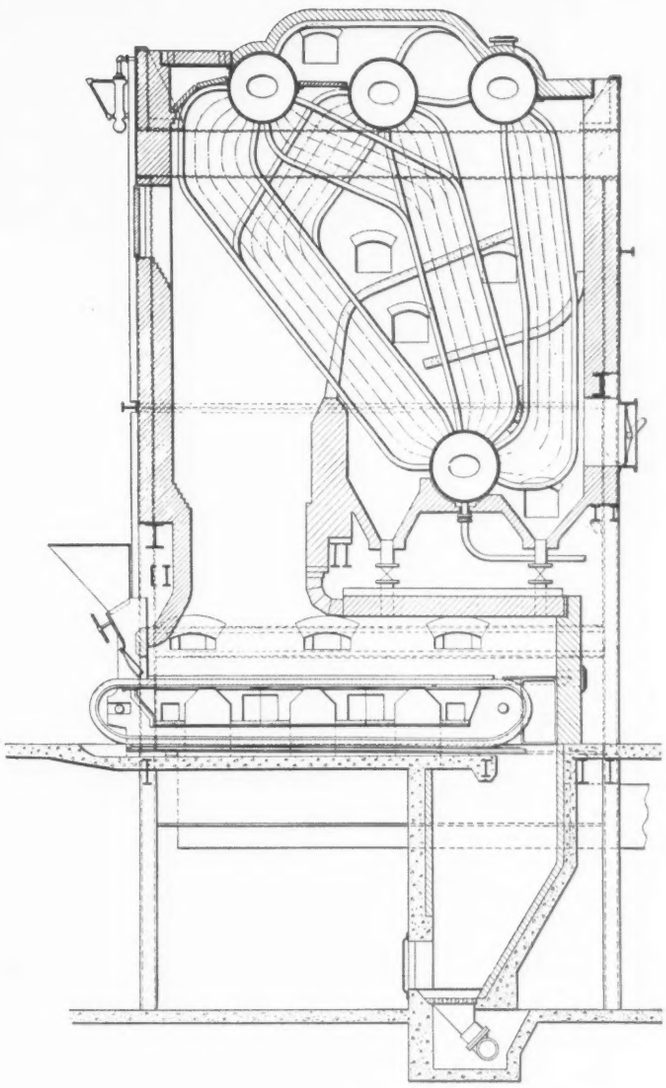
Consequently, when steam plant expansion was again considered in 1939, C-E was given the opportunity of re-presenting its original proposal. This time the more expensive installation was purchased. It consisted of two C-E 4-drum Boilers (VA Type), both fired by C-E Coxe Traveling Grate Stokers . . . each unit with a capacity of about 30,000 lb of steam per hr. The installation is now two years old. The customer reports with enthusiasm that it has more than fulfilled original guarantees. Even this brief period of service provides ample evidence that it will prove a great deal more economical *in the long run.*

C-E PRODUCTS INCLUDE ALL TYPES OF BOILERS, FURNACES, PULVERIZED FUEL SYSTEMS AND STOKERS; ALSO SUPERHEATERS, ECONOMIZERS, AND AIR HEATERS

COMBUSTION

...and a Change of Viewpoint...

An Authentic Account of
COMBUSTION ENGINEERING'S Service
(No. 13 of a series)



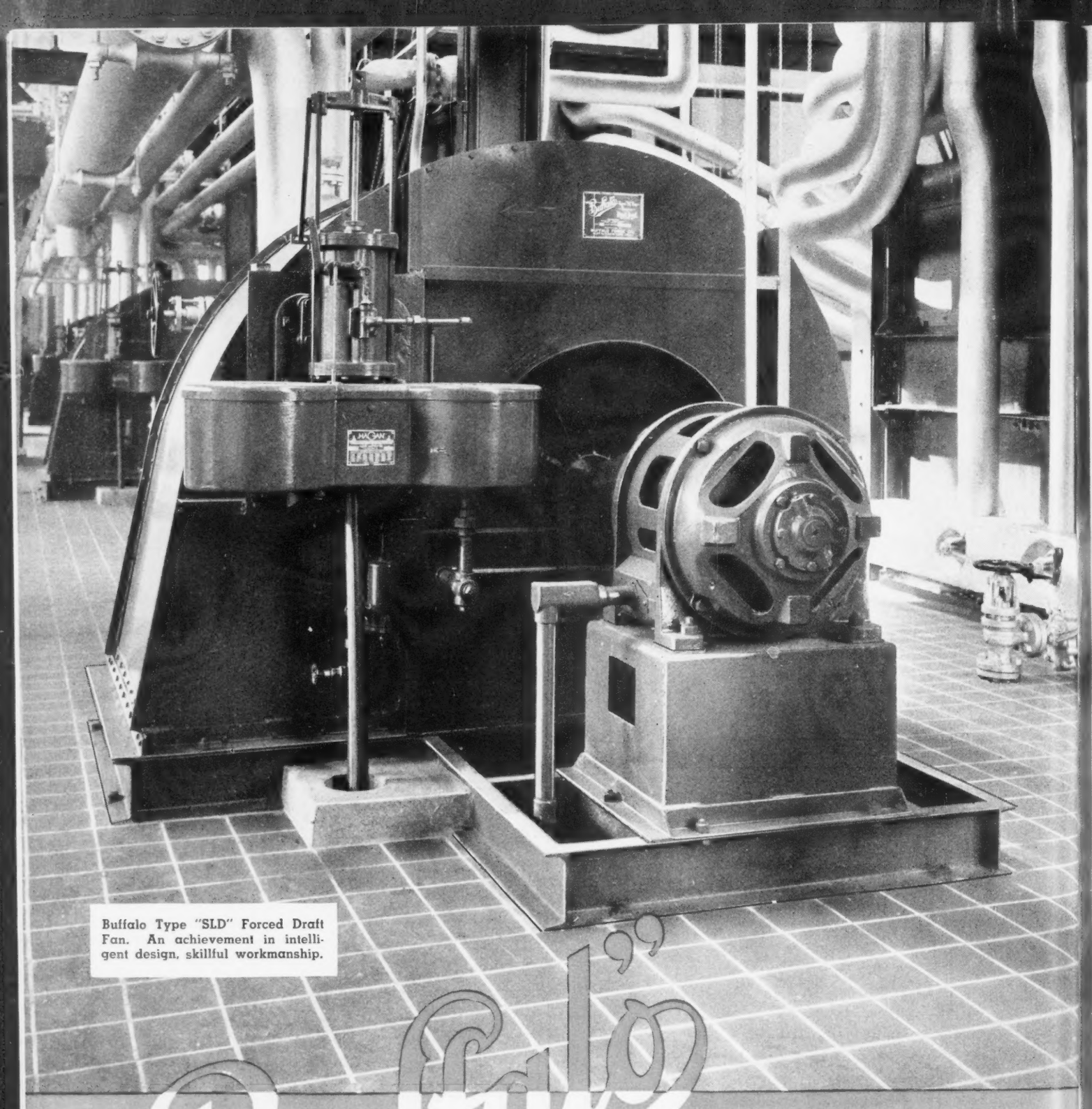
WHAT THIS MEANS TO YOU

The point of this story is not one of high *versus* low first-cost – for C-E frequently advises constructive cost-cutting where circumstances warrant. Its real significance is this: C-E has the experienced engineering skill to arrive at the one optimum solution to meet the particular combination of steam demand, fuel supply and other conditions existing for any job. Because C-E offers a complete line of steam generating equipment, it has the unprejudiced point of view toward alternative practices that eliminates the source of bias. Moreover, C-E has a reputation for long-run service satisfaction to protect, and every C-E proposal for steam generating equipment, large or small, simple or complex, must meet this standard.

Isn't it reasonable that you, too, will benefit by calling on C-E experience and equipment to meet your own needs for modern low-cost steam generation? A-636

COMBUSTION ENGINEERING COMPANY, INC., 200 MADISON AVENUE, NEW YORK, N.Y. • CANADA: COMBUSTION ENGINEERING CORPORATION, LTD., MONTREAL

ENGINEERING



Buffalo Type "SLD" Forced Draft Fan. An achievement in intelligent design, skillful workmanship.

"Buffalo"

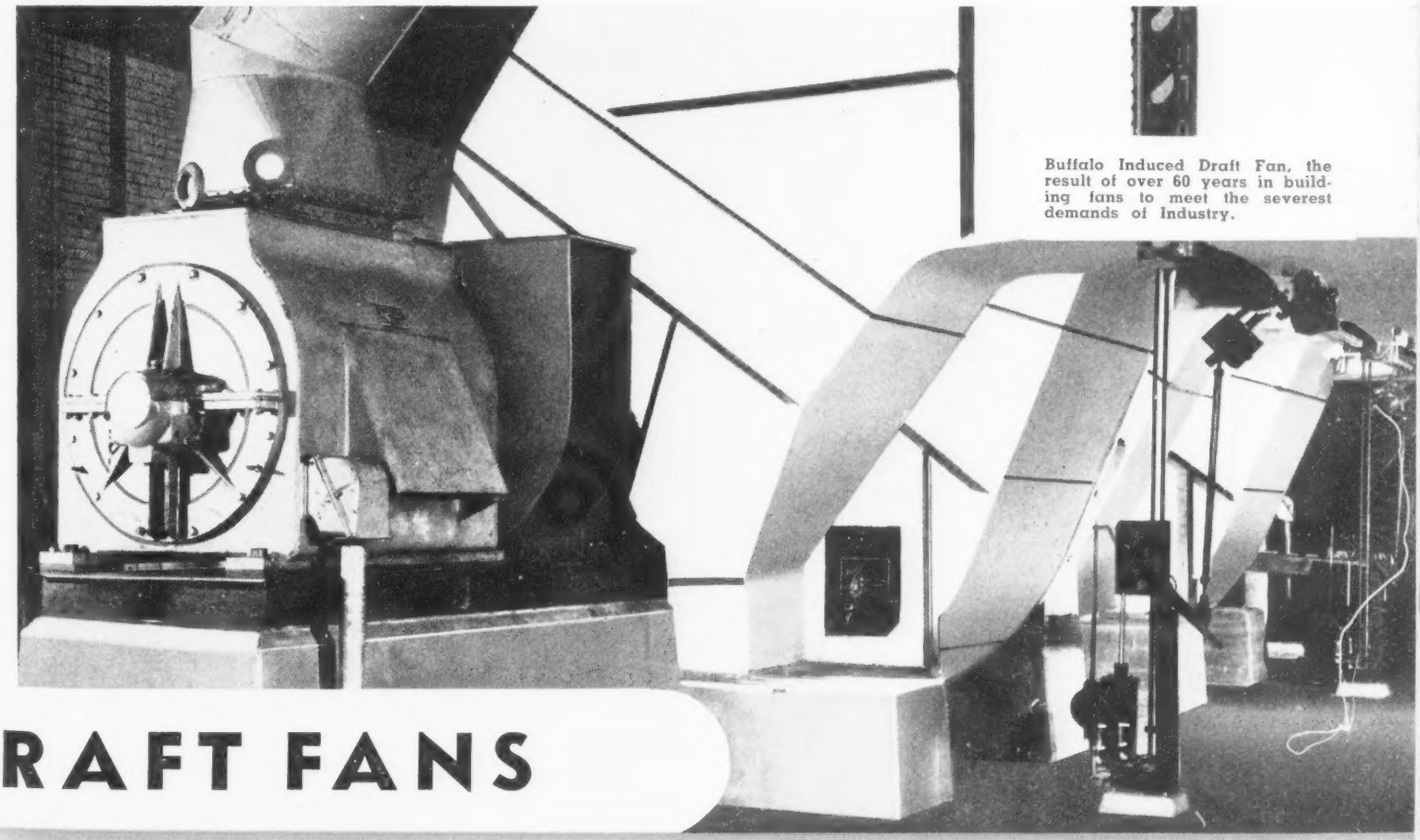
MECHANICAL

BUFFALO FORGE

KEEP 'EM *Blowing*

It takes plenty of air to keep our "arsenals of democracy" working at top capacity! But the power plant fans of the nation are equal to the task— despite emergencies which pile up extra burdens. Today, in some localities, steam plants are even called upon to take over the added load of hydro plants retarded by low water conditions. The job is being done—efficiently, unfailingly.

Buffalo Forced and Induced Draft Fans dependably contribute their share to help meet industry's demands. Built for peak-load operation on a twenty-four-hour-a-day schedule if need be, Buffalo Fans deliver the necessary mechanical draft with a minimum of care and attention.



Buffalo Induced Draft Fan, the result of over 60 years in building fans to meet the severest demands of Industry.

DRAFT FANS

COMPANY

488 Broadway, Buffalo, N. Y.

Branch Engineering Offices in Principal Cities
Canadian Blower & Forge Co., Ltd.,
Kitchener, Ont.

DEAERATOR CONTROL SYSTEM

Modern boiler operation demands the removal of dissolved air from boiler feedwater to prevent pitting and embrittlement. There are many variables that effect load changes on the boiler, and any load change that causes pressure variations in the Deaerator will decrease the efficiency of the dissolved air removal from the feedwater.

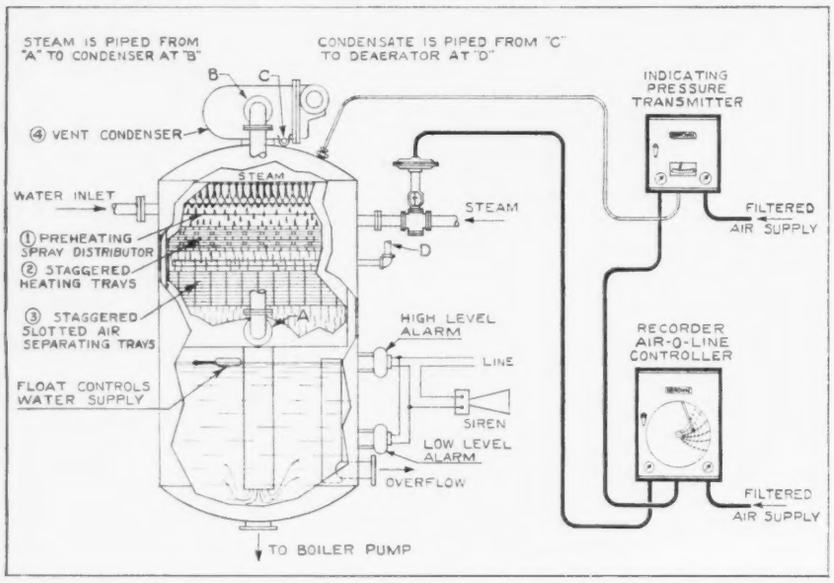


Figure 1. The Brown Remote New-Matic Deaerator Control System regulates steam input according to surges of pressure or flow, and provides reset action to compensate for load changes.

1. Principles Involved

Deaerators are generally located above feedwater equipment and at a point remote from the boiler control panel and, because of the low operating pressures carried on most Deaerators, the water head due to difference of elevation is great enough that sensitive, accurate control cannot be obtained if the deaeration head is suppressed in the instrument. It is therefore desirable to locate the pressure gauge at the level of the Deaerator. On the other hand, the recording controller should be on the boiler panel board. This is convenient when we use remote pneumatic transmission of the pressure to a recording controller located on the boiler control panel or at operating level, with its indicating transmitter located at the Deaerator. The *Brown New-Matic Remote Control System* is ideally suited for this application since it provides an indicating scale at the Deaerator where readings may be desired, and a recorder at any remote point in the boiler house.

The Brown New-Matic indicator mechanism transmits a change in air pressure as required by changes in Deaerator pressure, through a small bore tubing to the remote recording controller.

The transmitter consists of two main parts, the pilot valve and the transmitter mechanism. The purpose of the pilot valve is to amplify the nozzle pressure and greatly increase the volume of air for transmission to the receiving instrument. This pilot is a non-bleed balanced type, using air only when increasing the transmitted air pressure. It is pressure balanced by virtue of a double bellows, one of which is subjected to nozzle pressure and the other to the transmitted air pressure. The pilot valve is capable of increasing the transmitted air pressure for 90% of a total change from 2 to 15 pounds, with 500 feet of connected tubing, in 15 seconds. The same speed of response applies when the valve is exhausting.

A complete cycle of operation for an increase of pressure is given below:

1. With an increase of pressure, the connecting link to the transmitting unit moves to the right.
2. The movement of the connecting link rotates the flapper lifting lever around its pivot, shown just above the nozzle, and moves the flapper pin away from the flapper, allowing it to move downward and throttle the nozzle opening.
3. When the nozzle is throttled, the pressure in the bellows chamber is increased and the bottom of the bellows moves upward compressing the bellows spring. This movement of the bellows forces the bellows rod upward rotating the bell crank about its fixed pivot, and carries the flapper lifting lever with it. This movement continues until the flapper is in the exact position of maintaining the pressure at exactly the value that represents the new pressure, and there is no further movement of the bellows. For a decrease in pressure, the operation is merely the reverse of the above.

The actuating element of the Brown New-Matic receiver is similar to the transmitting unit except that it has no flapper and nozzle. The bellows and bellows springs are identical with those used in the transmitter unit and linear calibration is always obtained.

The liquid level alarm system is comprised of two Minneapolis-Honeywell high pressure water level cut-off switches mounted in such a way as to sound an alarm when the water levels are above or below the proper levels.

2. Application Data

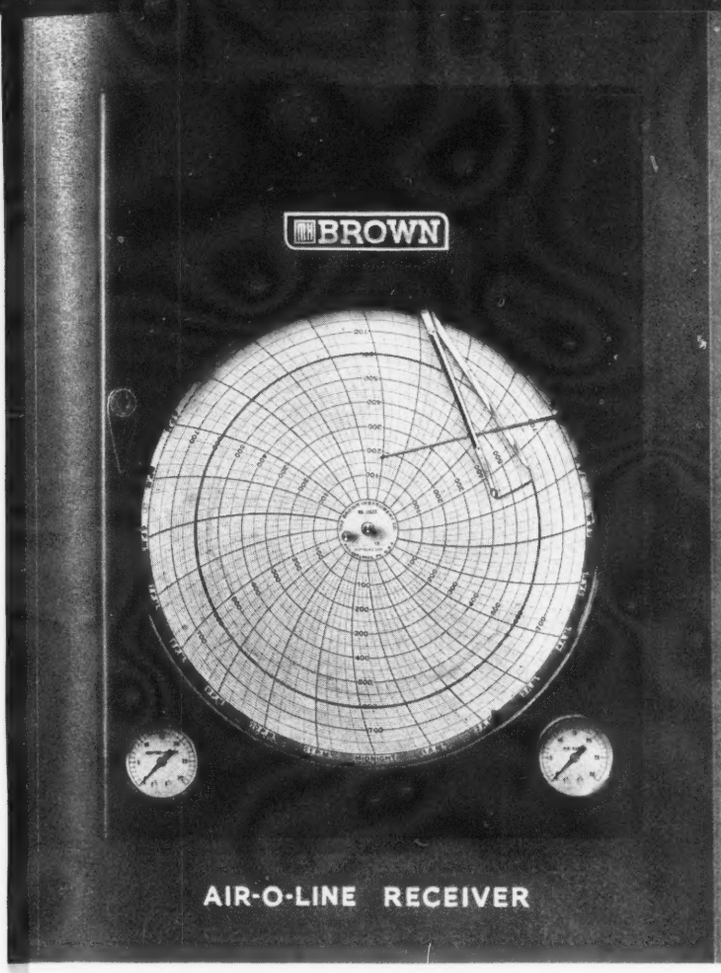
There are two common types of feedwater heaters—the closed or indirect type, which consists of a tubular heat exchanger with water in the tubes and steam in the space surrounding them, and the open or contact type, in which the steam and water are in direct contact. Each has its application: the first, where exhaust steam contains considerable oil or where high temperatures are required, and the latter, where deaeration and purification are desired and limited temperatures are sufficient.

Open heaters usually operate at from 1 to 5 pounds pressure and as the steam and water are mixed, both latent and sensible heat of the steam is absorbed by the water, resulting in a feedwater temperature being within ½° F. of the temperature of the steam at the heater operating pressure. Temperature control is extremely critical if deaeration is desired, and if steam binding in the feed pumps is to be avoided. The water temperature must be maintained constantly within ± 1° F. of the boiling point which is the equivalent of a pressure change of approximately $\frac{1}{8}$ lb. Unless sufficient quantities of exhaust steam are available at all times to insure this condition, a live steam cross over should be employed including a reliable and sensitive pressure regulator. Only under these conditions may complete removal of oxygen and other non-condensable gases such as CO_2 be accomplished. These gases are continuously vented to atmosphere, usually through a vent condenser, or heat exchanger. Steam binding of pumps, while no problem on a temperature rise, will always show on the slightest drop in temperature.

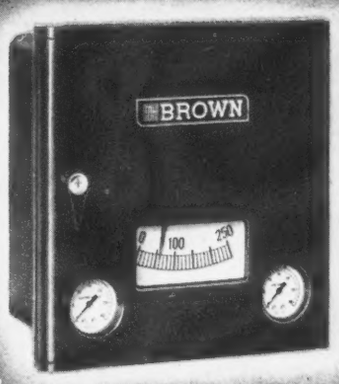
The Brown Deaerator Control System is particularly desirable because it has the following characteristics:

1. Responds to pressure changes rather than temperature changes, therefore responds to minute variations in conditions.
2. The New-Matic principle permits the use of remote transmission methods, and avoids errors due to water leg in tubing.
3. Control point may be adjusted conveniently at the panel board.
4. The transmitter is equipped with an indicating scale at the Deaerator.
5. If desired, the water level in the Deaerator may be recorded on the same chart as the pressure, by the simple addition of a level receiver unit in the recorder and an indicating level transmitter at the Deaerator.

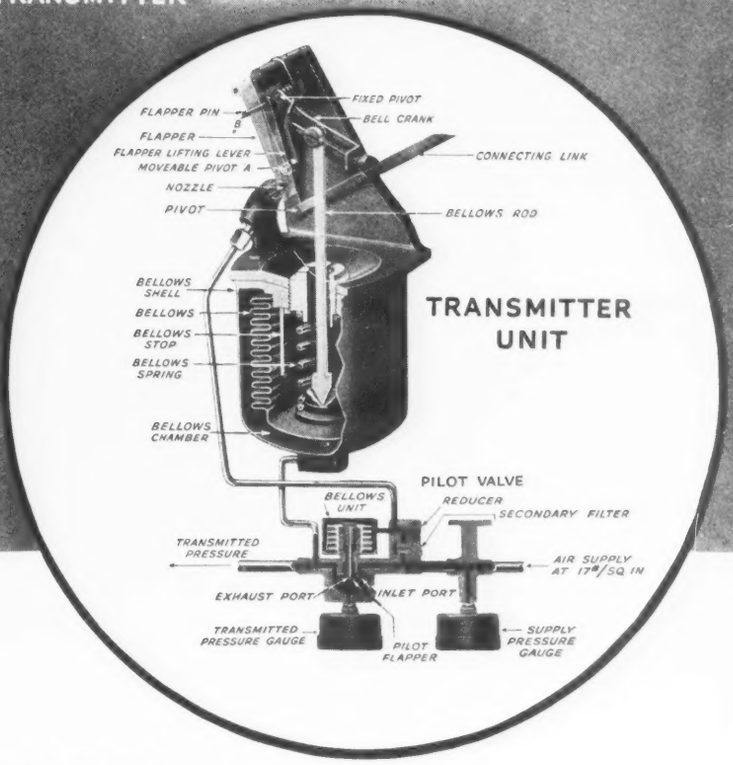
For complete details write THE BROWN INSTRUMENT COMPANY, *a division of Minneapolis-Honeywell Regulator Co.*, 4490 Wayne Avenue, Philadelphia, Pa.



AIR-O-LINE RECEIVER



INDICATING TRANSMITTER



Centralizes Remote Measurement and Control of DEAERATOR

All Brown "New-Matic" Systems are equipped with identical bellows in both the transmitting and receiving instruments. These bellows are factory "matched" to rigid specifications, insuring accurate calibration throughout the pressure range.

RESPONSE

Rapid rate of response is obtained through the use of a new non-bleed pilot. With tubing lengths as great as 1,000 feet, the receiver pen will travel through full scale at a rate equivalent to the most rapid rate of mercury differential change ever encountered in flow meter practice. With the thermometer transmitters it has been proven that the response is even more rapid than with long lengths of capillary.

ACCURACY

Positioning of the recording pen is guaranteed to within 1/10 of 1% of full scale range. Precision workmanship in all moving parts eliminates any appreciable hysteresis errors. The system is unaffected by ambient temperature changes of fluctuating air supply pressure.

POWER

The extra large spring and bellows design insures ample power for pen positioning and control mechanism operation. There is no "pen drag" or tapping error.

The Brown "New-Matic" Remote Transmission System is safe, stable, accurate and powerful, and lends itself admirably to the growing demand for centralized recording and control without any of the drawbacks attendant to long lengths of meter piping or capillary tubing, and where the use of electricity is not desirable.

Send for Catalog 9400

Write THE BROWN INSTRUMENT COMPANY, 4490 Wayne Avenue, Philadelphia, Penna. Offices in all principal cities.

BROWN *NEW-MATIC* TRANSMISSION SYSTEM

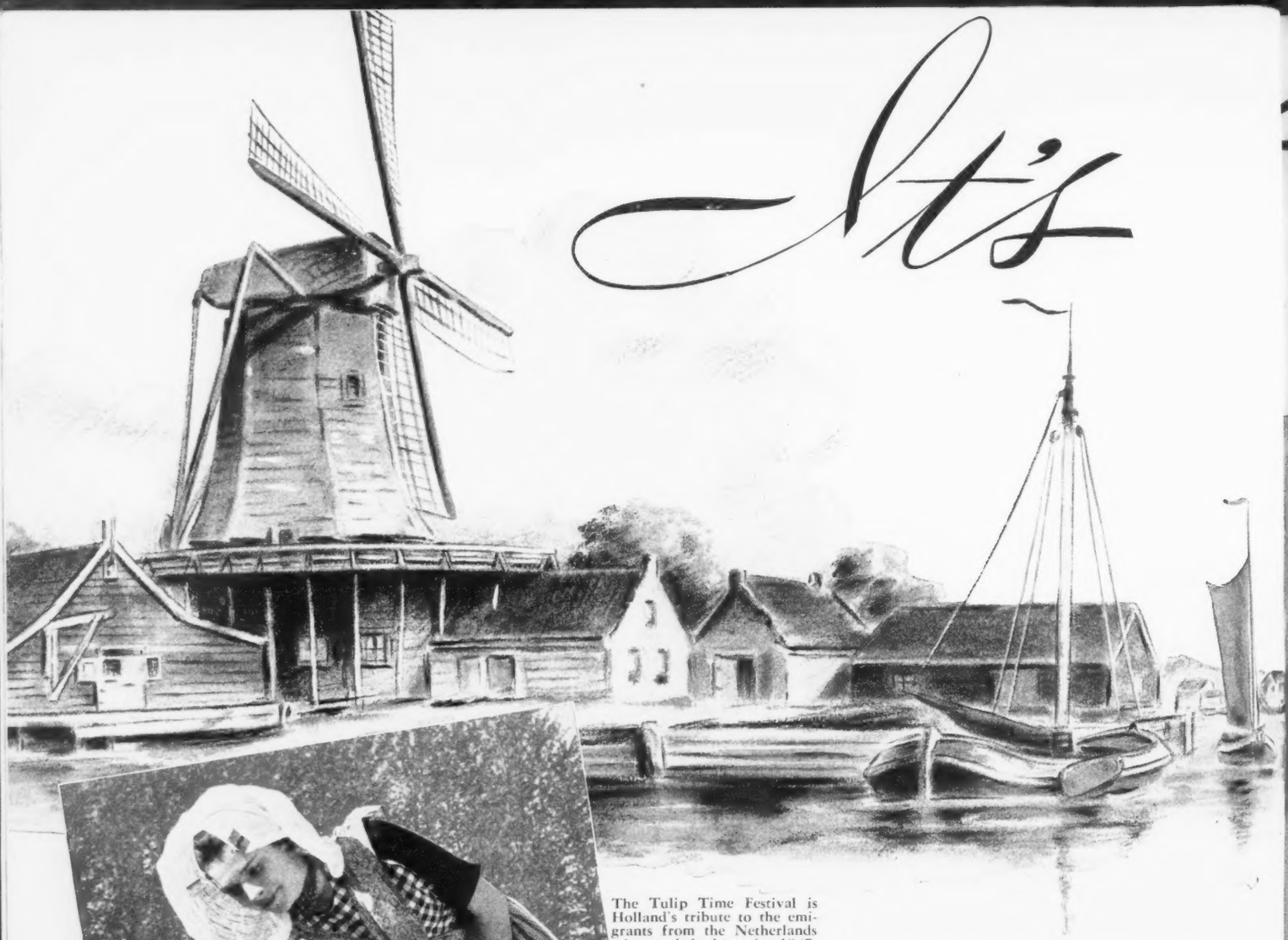
THE BROWN INSTRUMENT COMPANY, PHILADELPHIA, PENNSYLVANIA

DIVISION OF MINNEAPOLIS-HONEYWELL REGULATOR CO.

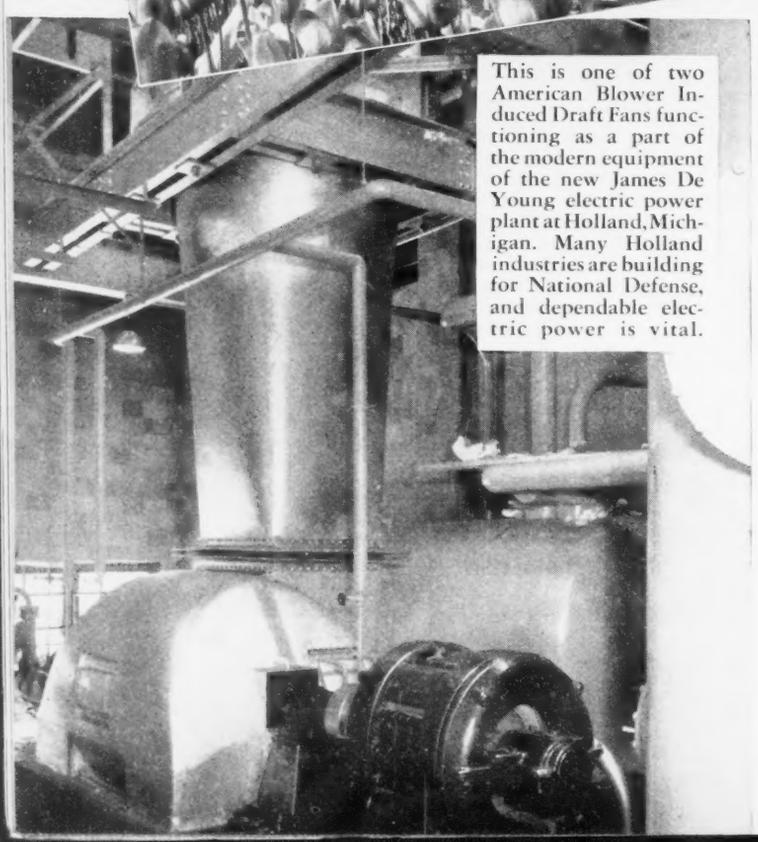
MINNEAPOLIS, MINNESOTA, AND 119 PETER STREET, TORONTO, CANADA

TO MEASURE AND CONTROL IS TO ECONOMIZE

It's



The Tulip Time Festival is Holland's tribute to the emigrants from the Netherlands who settled there in 1847.



This is one of two American Blower Induced Draft Fans functioning as a part of the modern equipment of the new James De Young electric power plant at Holland, Michigan. Many Holland industries are building for National Defense, and dependable electric power is vital.

A half-million visitors pilgrimage to Holland, Michigan, every Tulip Time, in May. They come to see the pageantry and color of the famous Tulip Time Festival. And invariably are impressed by the cleanliness, the beauty, the industrial and business activity in and about this "little bit of Holland."

Preponderantly Dutch in ancestry, the Holland population numbers 15,000. The city serves a trading area embracing 35,000 people. Two newspapers, two banks, thirty churches, no empty factories, popular resorts, and one of the lowest relief rolls in the country are among the assets the Chamber of Commerce enjoys boasting about.

Holland is proud, too, of the new James De Young electric generating station, completed in June, 1940. Built to meet the increasing demands of the 6,000 residential, commercial and industrial customers, the station has two 7,500 KWH generators. Further evidence of the foresighted planning behind this new, modern station are the American Blower Forced and Induced Draft Fans functioning in it. Perhaps you are now planning an improvement program calling for Mechanical Draft, Dust Precipitating or Fluid Drive (Hydraulic Coupling) equipment. May we have the privilege of serving you?

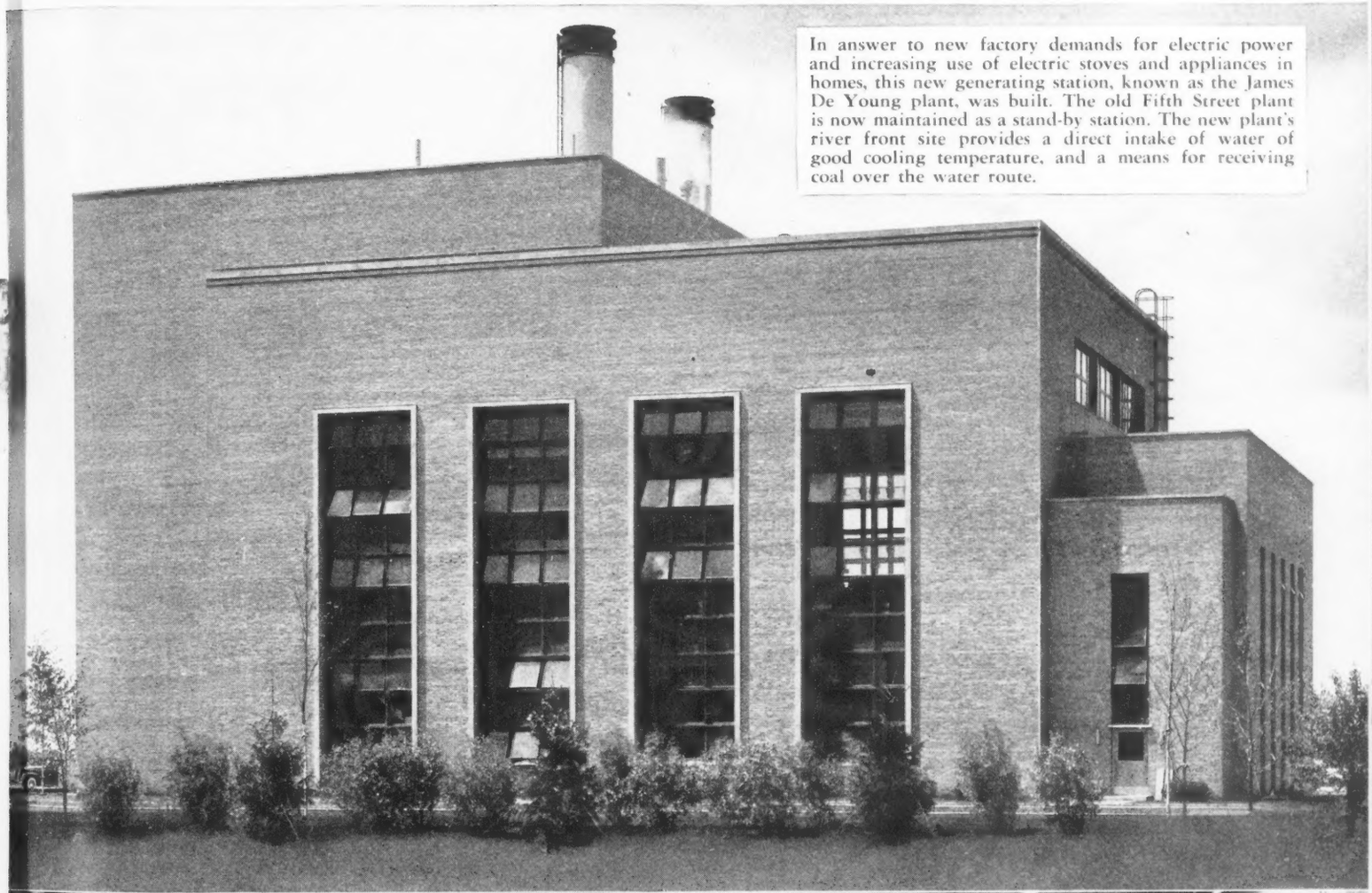
AMERICAN BLOWER

AMERICAN BLOWER

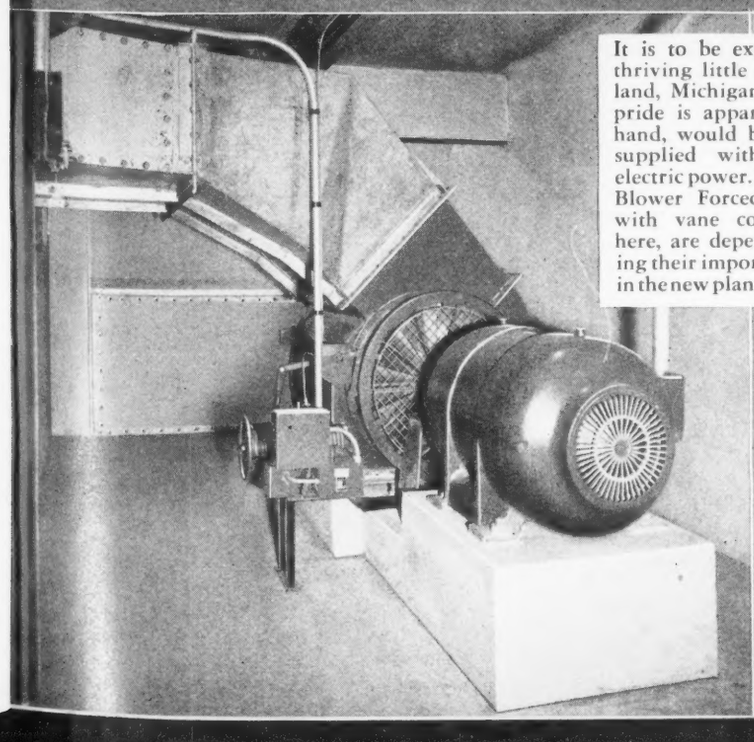
AMERICAN BLOWER CORPORATION, 6000 Russell Street, Detroit, Mich.
CANADIAN SIROCCO COMPANY, LTD., WINDSOR, ONT.
Division of American Radiator and Standard Sanitary Corp.

Tulip Time

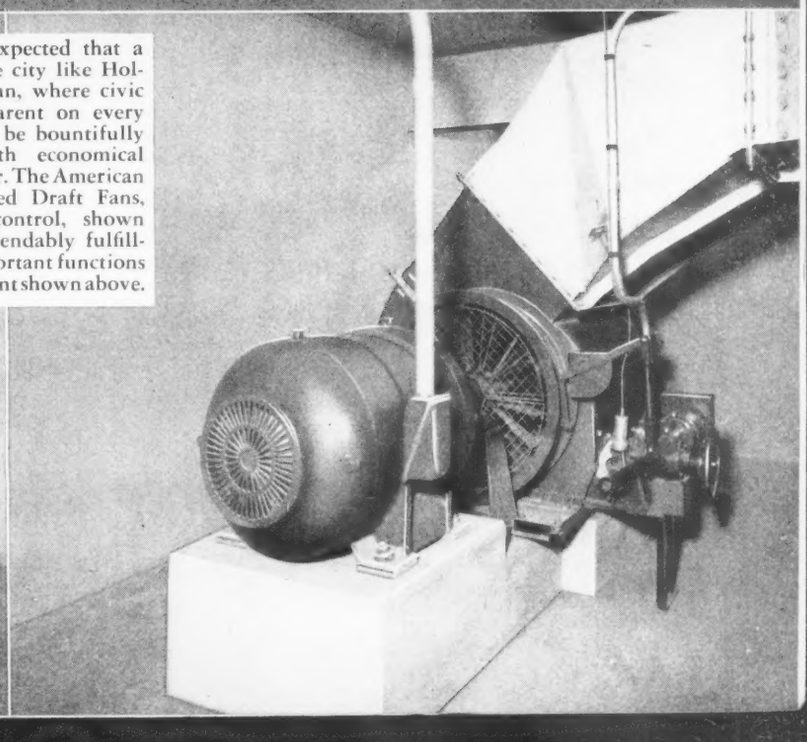
IN HOLLAND, MICH., EVERY YEAR IN MAY



In answer to new factory demands for electric power and increasing use of electric stoves and appliances in homes, this new generating station, known as the James De Young plant, was built. The old Fifth Street plant is now maintained as a stand-by station. The new plant's river front site provides a direct intake of water of good cooling temperature, and a means for receiving coal over the water route.



It is to be expected that a thriving little city like Holland, Michigan, where civic pride is apparent on every hand, would be bountifully supplied with economical electric power. The American Blower Forced Draft Fans, with vane control, shown here, are dependably fulfilling their important functions in the new plant shown above.



SEAMLESS PIPE

When your high-pressure steamlines are J&L Seamless Steel Pipe you are sure of utmost safety.

J&L PIPE

J&L TUBULAR PRODUCTS

Welded and Seamless Standard Pipe
Seamless Steel Boiler Tubes
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Permalined (cement-lined) Pipe

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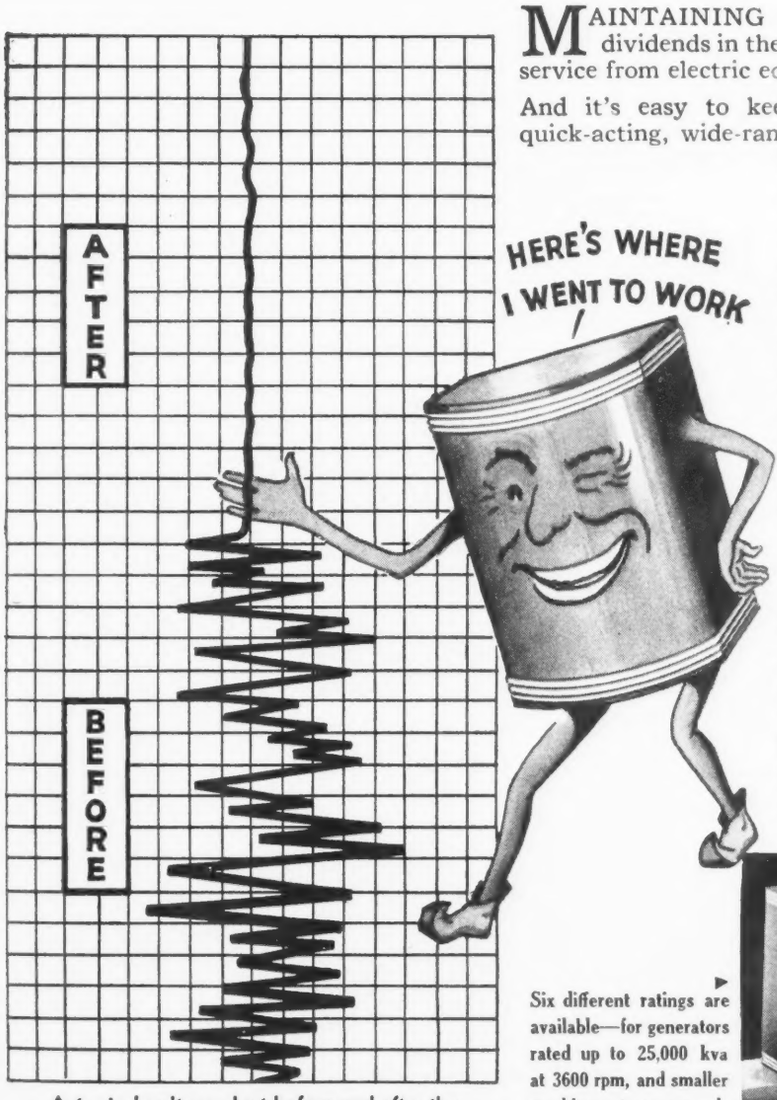
If You Generate Power...

Use DIACTOR Regulators for Smooth, Steady Voltage



A typical voltage chart before and after the application of a G-E Diactor regulator

MAINTAINING steady voltage at all times pays handsome dividends in the form of longer life and better operation and service from electric equipment.

And it's easy to keep generator-voltage curves smooth—with quick-acting, wide-range G-E Diactor regulators. These compact little regulators hold the normal voltage close to the desired value without hunting or instability. After a change in operating conditions, they quickly return the voltage to normal. And, because of the simple, reliable design, you're not troubled with bothersome, costly maintenance.

Whatever your voltage problem, there's a Diactor regulator suited to your need. Just call or write the G-E office near you, and a specialist will be glad to call and discuss your particular case. Or ask for Bulletin GEA-2022D. General Electric Company, Schenectady, New York.

DIACTOR REGULATORS GIVE YOU . . .

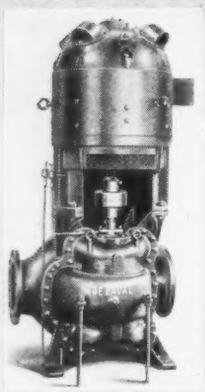
Direct action—for fast operation
Electrical damping—no dashpots
Reliability and long life—no vibrating contacts
Easy installation—small and compact
Normally stationary parts
Simple construction—only six leads required

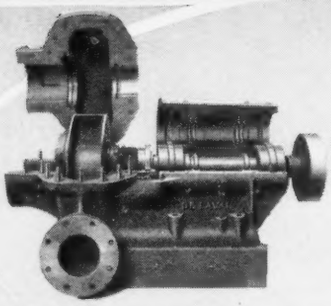
Six different ratings are available—for generators rated up to 25,000 kva at 3600 rpm, and smaller machines at correspondingly lower speeds

GENERAL ELECTRIC

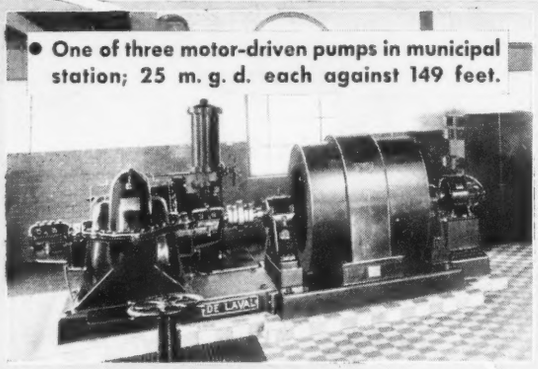
352-5

A DE LAVAL PUMP
to fit your job



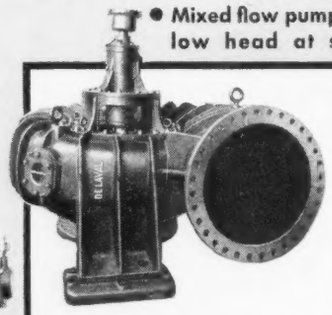


• Clogless pump, for paper pulp, sewage, etc.

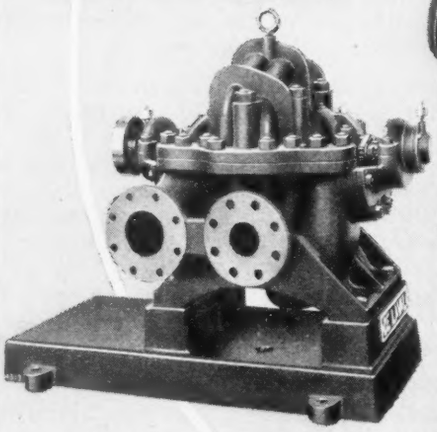


• One of three motor-driven pumps in municipal station; 25 m. g. d. each against 149 feet.

• Mixed flow pump, for large volume against low head at standard motor speed.

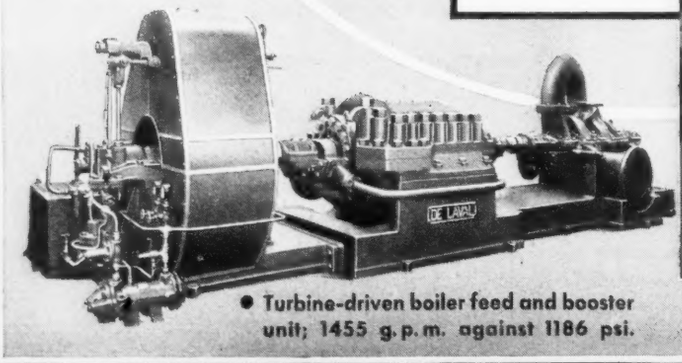


• Condenser circulating pump for salt water; bronze bearings, monel shaft and impeller.

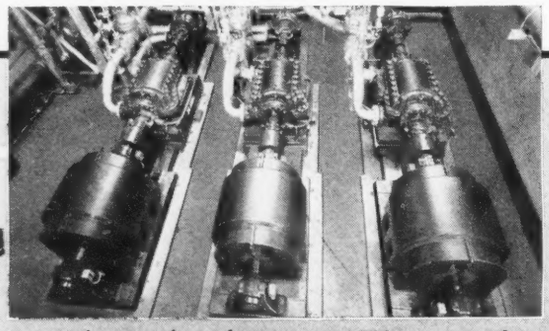


• Opposed impeller pump; compact; perfectly balanced; only two pairs of wearing rings.

INFINITE combinations of capacities, heads and speeds require careful design of each centrifugal pump to insure best efficiency and desired operating characteristics. • Where a liquid having a destructive effect on standard materials is to be handled, the life of a pump can usually be increased many times over, and its average efficiency improved, by using special alloys for casing, impeller, sleeves, wearing rings and shaft. Only by careful study of user's conditions are the best results to be obtained. • State your pumping requirements in detail so that the engineers of our Centrifugal Pump Department may give you all the benefit of their extensive experience. Ask for Leaflet P-3220.



• Turbine-driven boiler feed and booster unit; 1455 g.p.m. against 1186 psi.



• Multistage de-scaling pumps; 1200 g.p.m. each against 1200 psi. at 1750 r.p.m.

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MANUFACTURERS OF TURBINES . . . STEAM, HYDRAULIC; PUMPS . . . CENTRIFUGAL, PROPELLER, ROTARY, DISPLACEMENT, MOTOR-MOUNTED, MIXED-FLOW, CLOGLESS, SELF-PRIMING; CENTRIFUGAL BLOWERS and COMPRESSORS; GEARS . . . WORM, HELICAL and FLEXIBLE COUPLINGS

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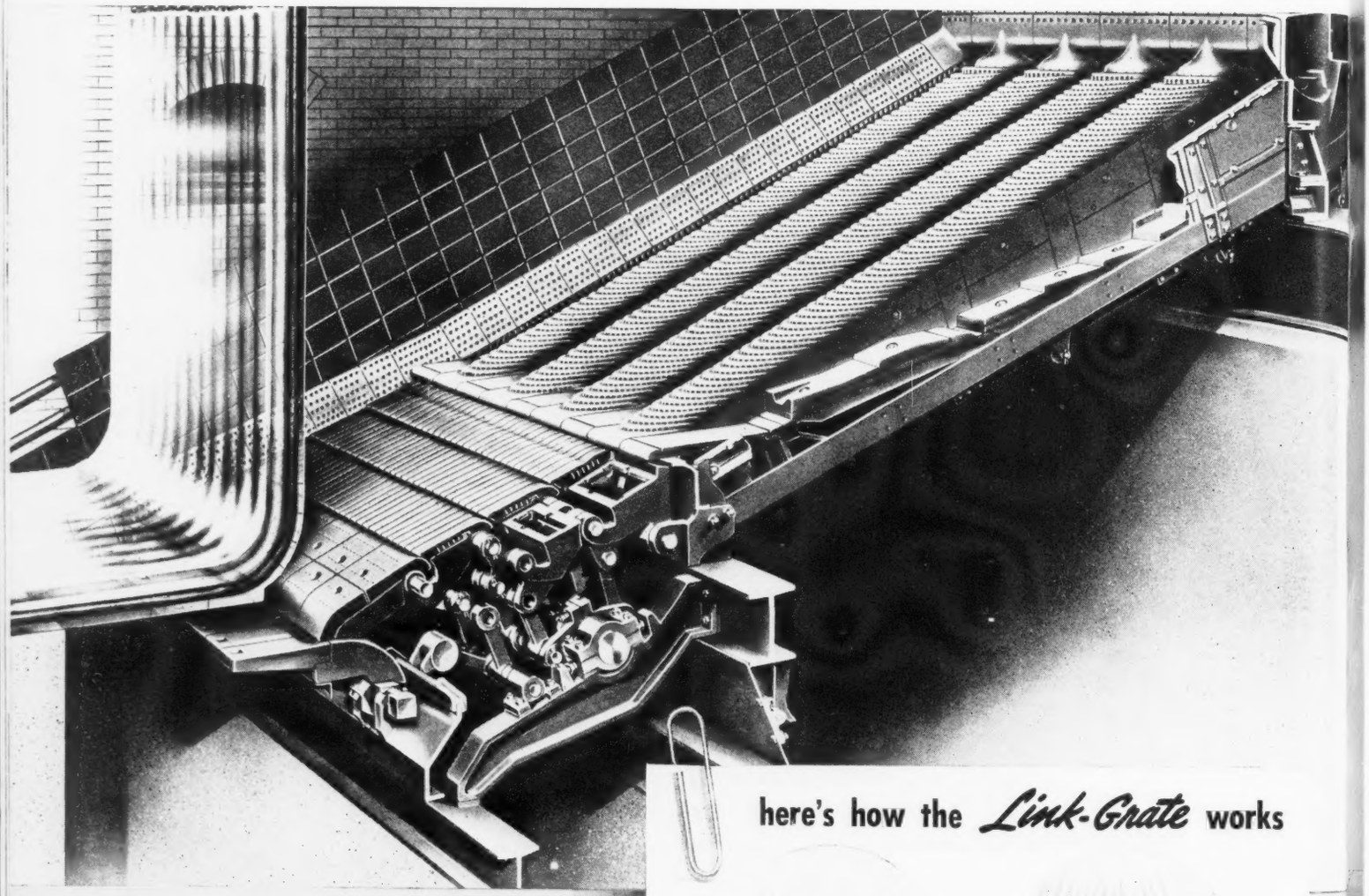
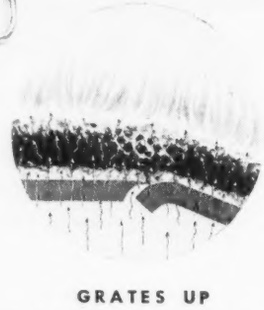
are **common**

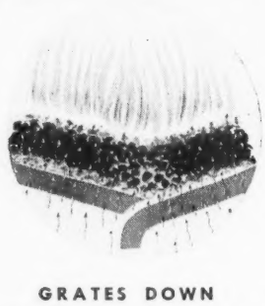


here's how the *Link-Grate* works



GRATES UP

Fuel bed opened, thoroughly permeated with low-pressure air. Fused ash oxidized, clinkers broken into small, friable pieces.



GRATES DOWN

Fuel bed cracked, crumbled and made porous for uniform flow of gases throughout entire combustion zone.

f 6 to 12 months

with *Link-Grate* Stokers

"Are you getting this kind of performance from your stokers?"

• Westinghouse Link-Grate Stokers have built-in features and basic design elements that keep them in continuous service month after month. The records prove it. Sound principles of combustion efficiency explain it. Here is the *why* of Link-Grate's high availability!

LINK-GRATE MOTION, a unique Westinghouse feature, processes the fuel bed for thorough combustion and prevents the formation of troublesome clinkers. There is no need for periodic hooking or barring. Since the fuel bed is kept porous and uniform, thin spots are reduced and there is less tendency to blow through. Consequently, grate burnouts are minimized.

AIR-DIFFUSING DESIGN of both Link-Grates and tuyeres is another reason why grates seldom need to be replaced. Projections in the air stream promote diffusion and thorough cooling of grates. Because of this same design element, there is a more thorough mixture of coal and air in the fuel bed, and low-pressure air can be used to promote combustion. Matted fires and air blasts are no longer a problem.

CONTINUOUS ASH DISCHARGE is a fact, not a theory, in Link-Grate stokers. Link-Grate motion keeps the entire fuel bed progressing toward the ash discharge at a controlled rate of movement. Periodic dumping is not required.

J-50397

Today and tomorrow . . .
the *Link-Grate* stoker is an investment in low-cost power

The very same Link-Grate features that spell High Availability today—promise power at lowest cost for the post-emergency years. With *this* stoker you can use whatever grade of coal is available, with maximum efficiency. You'll save on maintenance and repair costs, prevent production delays. Investigate the Westinghouse Link-Grate Stoker.

Power at Lowest Cost

High availability is only one of many factors contributing to the proved low cost of power from a Link-Grate stoker. *See* one in service. Talk with the plant management. Get the performance figures. A Westinghouse representative will arrange a visit for you. • In the meantime, send for these Link-Grate fact-books: Bulletin 3039 on multiple retort stokers, Booklet 2196-A on single retort stokers. Address Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., Department 7-N.

Westinghouse

MORE

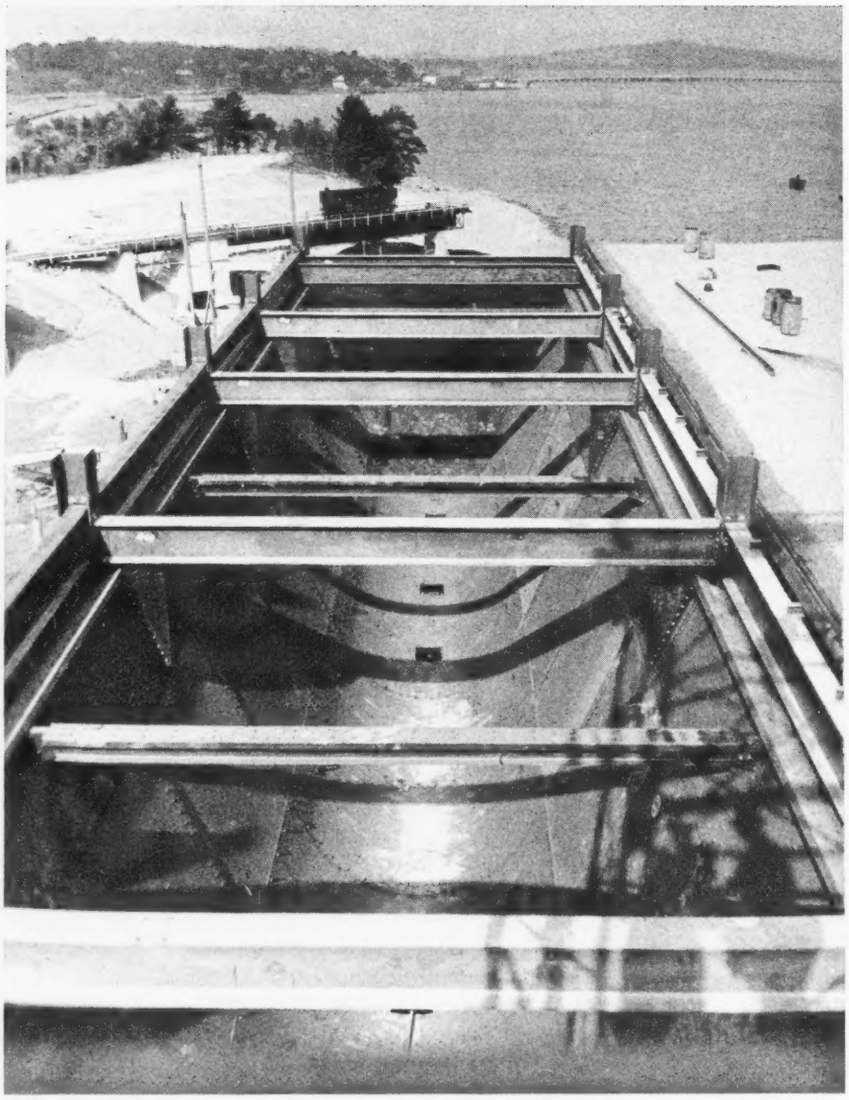
OF THE MANY SERVICES WHERE

HELPS CUT MAINTENANCE COST

The cost and the consequences of equipment failures are pyramided today by scarcity of materials, higher costs, and lost production. The selection of dependable materials takes on new importance . . . and the contribution that wrought iron can make becomes of even greater value.

Here are four more of the many places where engineers are using wrought iron to cut maintenance costs, and reduce shut-downs . . . but no list can suggest its complete possibilities. If you have any problem involving corrosion or fatigue, ask our Engineering Service Department to give you authentic service data on the performance of wrought iron in similar situations.

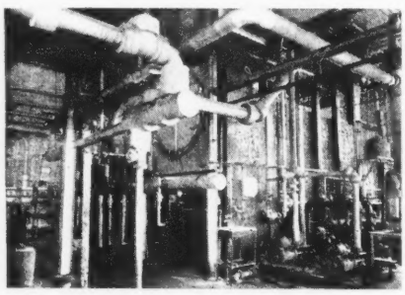
A. M. Byers Company, Pittsburgh, Pa., Established 1864. Boston, New York, Philadelphia, Washington, Chicago, St. Louis, Houston, Seattle, San Francisco.



Increased coal demands due to defense activity have caused many plants to ease up on fuel specifications which generally means corrosion trouble for coal handling equipment unless a proven corrosion-resisting material is used. In this new bunker, Central Maine Power Company avoided possible difficulties by using Byers 3/8" Genuine Wrought Iron Plates. If you have any similar problem, ask for our bulletin "Wrought Iron for Flue Gas Conductors and Coal Handling Equipment."

Central Maine Power Co. also used wrought iron for this penstock. It handles salt and brackish river water for condenser cooling. Another user reported a 5' penstock of wrought iron still serving after 52 years.

Underground installation of plant electrical distribution systems is often desirable. Byers Wrought Iron Conduit gives dependable protection to the cables. It is highly resistive to soil and water corrosive attack.



Hot and cold water supply lines, boiler feed lines, and heating return lines in this midwest plant boiler room are genuine wrought iron—installed after comparative tests had proven its superior corrosion resistance.

BYERS GENUINE WROUGHT IRON

TUBULAR AND HOT ROLLED PRODUCTS

STEEL TUBULAR PRODUCTS

What Can I Do?

EVER SINCE that Sunday morning when havoc swooped from the skies upon Honolulu, a new question has been churning about in millions of American minds. It is this: What can I do to help my country win this war?

This insistent question has pushed aside all matters of personal interest. From now on, individual wants and wishes must give way to the paramount needs of the nation. We all accept that. We have undertaken a huge job. Or, I should say, we have had a huge job thrust upon us. And unless we see that job through successfully it won't much matter what any of us may want.

That job is to win this war.

No longer are we trying to prepare for a war that we may get into. Today we are trying to win a war we're already in—and in up to our eyes. Nothing that any one of us now can do to help himself can get him very much if it does not also help our country to win this war.

I am sure that those who read these words will find many things to do. Some will enlist in the armed services. Some will become active in civilian defense. Some will labor to relieve distress in their home towns. Some will work with organizations set up to serve the men at the front. Each can and will find something he can do.

But this insistent question "What can I do?" goes beyond the individual and his personal service. It re-echoes through the offices and the shops of every American business concern. And what I have to say here is not directed toward individual effort. Rather is it intended for the men and women of American industry who make that industry a living part of American life. Today they are asking themselves: What can industry do? Or better still, what *must* industry do if our country is to finish the job it has started?

Those of us who work in and with American industry have one supreme obligation. We may feel very patriotic; we may be willing to serve "in any capacity;" we may be willing to sacrifice . . . if necessary. But if we fail to meet that one obligation, we shall fail our country in its time of need.

THAT SUPREME OBLIGATION IS AN HONEST DAY'S WORK, EVERY DAY, FROM EVERY MAN, EVERY WOMAN, EVERY MACHINE. . . .

IT IS AS SIMPLE AS THAT!

And that goes for all of us, whether we are engaged in civilian production or working directly on the weapons of war. American victory can be won only through the productivity of American industry.

Efficiency in production is not the responsibility of a few. It can be achieved only as we all put to useful purpose every minute of our time, every ounce of our energy, and every pound of our materials.

This responsibility of industry is the more vital because of what has happened to the business of making war. There was a time when success in war was chiefly a matter of well-trained, well-disciplined armies and competent leaders—when men were everything. In those days, military strength was a matter of strong battalions and able generals. Both still are vital. But today military might is essentially mechanical might. Modern war is an industry just as much as a factory or a railroad. In the first World War, mechanical equipment was relatively simple and limited. But today the special equipment of war and the expert skill needed to use it spell the difference between victory and defeat.

We Americans are not expert war-makers. That is why we must expect to suffer grievous losses before we can win substantial gains. We do not have military training and experience ready to hand when we need them. Neither do we have, ready for action, enough of the machines that are so essential to modern warfare.

So, when it becomes necessary to fight for our lives, we must start from scratch. And today, after a year's effort, we still are not ready to trade blow for blow with enemies who for years have schooled their leaders, trained and disciplined their people, and organized their industries to make war. We shall need more time to develop our strength. And while we are doing that, we must expect reverses.

But there is a brighter side to all this. For it follows that if we are granted this all-important time, the change in the method of warfare is right down our alley. The greater importance of mechanized equipment plays straight into the hand of the world's greatest industrial nation . . . if there is one thing America *does* know, it is industrial production! Our industries know how to produce. They have the skilled manpower. They have the organized facilities. Beyond any doubt, we can produce all that we need to win the victory that we *must* win—if only we are given the time.

THE FIRST RESPONSIBILITY OF THE ARMED FORCES IS TO GAIN THAT TIME FOR US.

THE FIRST RESPONSIBILITY OF INDUSTRY IS TO USE TO THE FULL EVERY SECOND OF THAT TIME IN PRODUCING THE WEAPONS

THE ARMED FORCES NEED TO WIN THE ULTIMATE VICTORY. INDUSTRIAL PRODUCTION IS THE KEY TO VICTORY. BUT IT MUST BE BIGGER PRODUCTION AND FASTER PRODUCTION THAN WE EVER HAVE KNOWN.

Heretofore American industry has worked to produce more of those things which make our lives more enjoyable. Today it must divert much of its energy from the products of peace to the weapons of war.

This change sets up a new yardstick of industrial performance. In time of peace we measure production efficiency in terms of money saved. From now on, we must measure efficiency chiefly in terms of time saved. For the plane, the tank, the gun, or the ship that is ready when it is needed to win a victory, is worth a million times more than the one that is delivered too late to avert a defeat.

Everyone knows how short we are of some materials and machines. But our most tragic shortage is the shortage of time. So whatever we may waste in the days ahead—and unhappily we are bound to waste plenty—let us never forget that the most deadly waste of all is the waste of time.

Time wasted never can be replaced. No one ever has discovered a substitute for time. If we would avoid the waste of this irreplaceable ingredient of victory, we must use every minute of it effectively—*while we still have it.*

That goes for us all. It goes for the man or the woman at the bench, at the desk, at the counter, in the field, or in the executive office. It goes for the politician as well as for the business man. It goes for the humblest and the most powerful. A nation at war cannot carry deadheads. It cannot spare a square foot for any one who will not pull his weight.

In this war, nothing short of complete victory can save the liberties of us all, rich and poor, employer and employee, haves and have-nots alike. The price of that victory is the labor, the loyalty, and the devotion of every last one of us. Winston Churchill said it well for the British people. You know how he said it. I need not repeat it.

All this imposes upon American industry, its owners, its managers, and its workers, the gravest responsibility they ever have assumed. If our country is to survive as a free nation, American industry must rise to that responsibility. If our country should fall, it would fall because American industry fell short of the need. It would be another case of "too little and too late".

This grave responsibility calls for the keenest management industry ever has known. It calls for unremitting research to make the most of our resources. It calls for the reduction of waste to a record minimum: that goes for waste of time, labor, and material. It calls for keeping our machinery working as near to full capacity as we can contrive. It calls for the highest rates of unit production we ever have known. That will mean skillful coordination by management and the most intelligent cooperation that the men in the shops can give. It calls for inventive ingenuity to match that of a nation which has produced some of the world's outstanding technical genius. For this is a war of technical proficiency.

But above all, it calls for a new devotion to the day's work. For so long as we are at war, the day's work will determine our country's security.

Whatever may be our material resources and our technical skill, however resourceful our management, however broad the scale of our effort, industry cannot measure up to its prodigious responsibility if any of us shirk the day's work. Right there is where we find the one thing we *all* can do—the one thing that is within the power of each of us.

THAT ONE THING IS SIMPLY TO DELIVER AN HONEST DAY'S WORK WHEREVER WE ARE CALLED TO SERVE. HONEST WORK WILL WIN THIS WAR. LOAFING WILL LOSE IT. THE SHOWDOWN WILL BE WHETHER HITLER CAN DRIVE HIS PEOPLE TO WORK HARDER THAN WE ARE WILLING TO WORK. THERE IS NO ONE TO DRIVE US. WE MUST DRIVE OURSELVES!

Is that so much to ask? It is all our country asks of us, the men of industry. It is all that the men who must work the guns and tanks in the field ask of us. It is all that the men who work our ships and our planes ask of us. "Give us the planes, the guns, the ships, the tanks, and all the rest of our tools," they tell us, "and we'll give you the victory that means so much to us all. But, in the name of that victory, give them to us quickly—QUICKLY—QUICKLY!"

Is that, I repeat, too much to ask of us?

* * * *

To help American industry achieve ever-higher standards of efficiency has been the traditional mission of McGraw-Hill for three-quarters of a century. Normally that effort has been directed toward higher efficiency in the business of peace. But, as in the first World War, twenty-five years ago, it now is directed toward efficiency in the business of war and in every department of American effort that can contribute, directly or indirectly, to the achievement of victory.

And to that mission, I here pledge every resource of this company, its publications, its books, its staff, and every service it is qualified by experience and training to render to American industry, now enlisted in our common cause.

That is what we of McGraw-Hill can do. And that is what we *shall* do to our utmost.

President, McGraw-Hill Publishing Company, Inc.

This message is appearing in all McGraw-Hill industrial and business publications, reaching over a million readers.

POWER

Established 1882 • PHILIP W SWAIN, Editor

The Job Ahead

When America entered a declared war with the Axis powers, it was clear to us that POWER, like every other American institution, must justify its existence by its contribution to the ultimate victory. We had just two questions: "What is the most effective service we can render to the national war effort? How to go about it?" Our reasoning and conclusions may be summed up as follows:

This war will be won by the Allied military operations, backed by the greatest productive effort in the world's history. The job of the power engineer is concerned with war *production.*

That job is to maintain the power supply at all times, particularly to the defense industries and to such essential services as transportation, communication and city light, water and gas. In the case of the industrial plant, this means adequate supplies of steam, hot and cold water, compressed air and refrigeration, as well as of electricity and mechanical power.

Effective capacity may be limited or reduced by fire, explosion, sabotage, bombing—also by poor planning, improper maintenance, waste in generation, transmission and application—and in many other ways.

Clearly, then, it will be POWER's war-time job to pass along to readers all available practical information on how to keep plants going under all conditions of danger or overload, how to expand or improvise capacity in an emergency, how to maintain equipment, how to make a given supply of power services go further. Because we have always dealt with the practical problems of operation and maintenance, this will call not for a reversal of editorial policy but rather for a shift in emphasis.

The editors will proceed at once to convert this general plan into action, in two specific ways:

1. Each month, a POWER special section will present complete and authoritative information on some particular phase of the two basic war-time power problems: (A) stretching existing capacity, and (B) maintaining continuity of service.

2. A new "clinic" department will provide operating engineers with a means for exchanging practical solutions to emergency situations.

In addition, every effort will be made to make each article and department fit the vital needs of these times.

1250-Lb Oswego Tests New Ideas

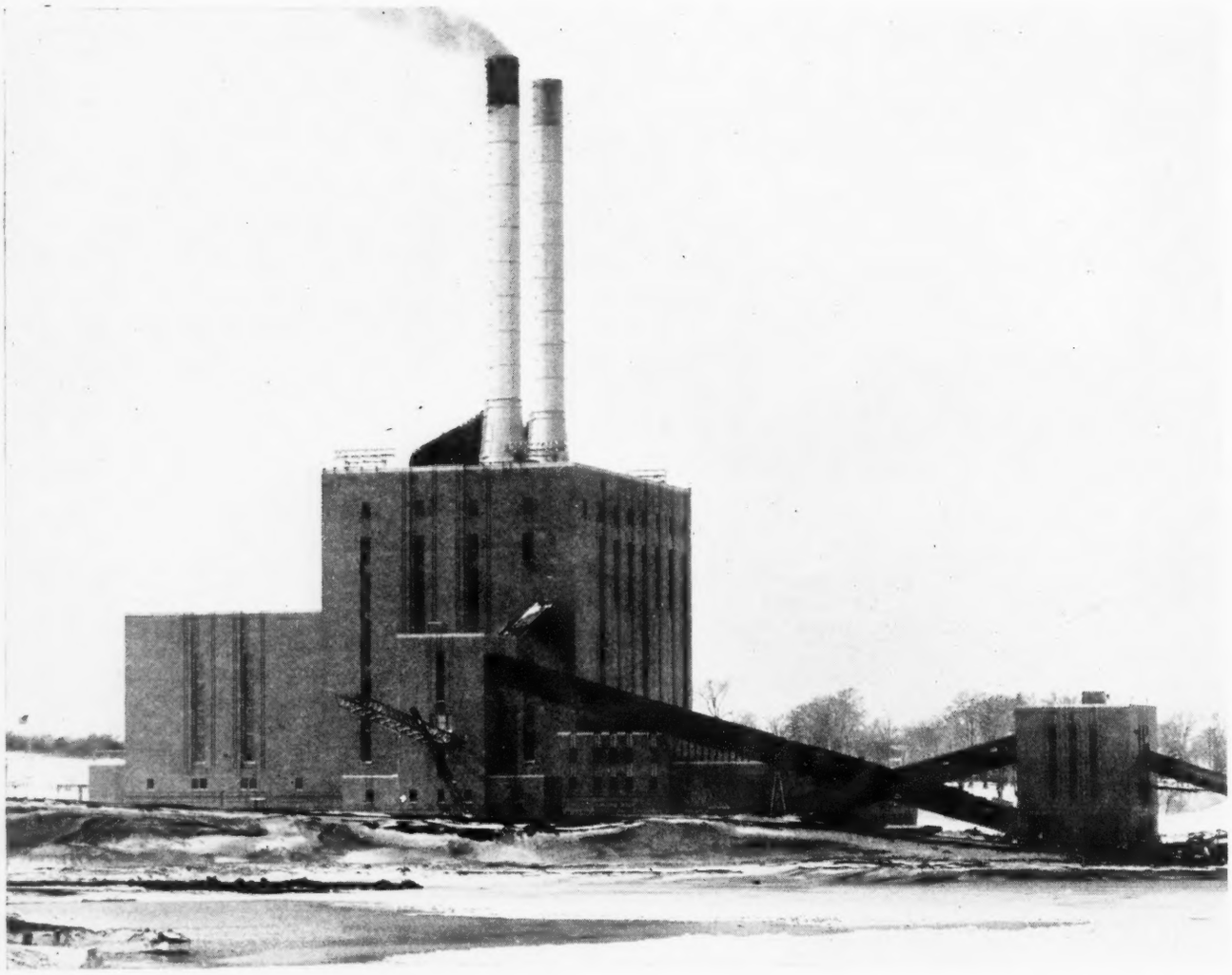


Fig. 1—On the shore of Lake Ontario and designed for an ultimate capacity of 400,000 kw, Oswego station receives coal by rail or water to carry base load or serve as hydro standby for far-flung Niagara Hudson system extending from Buffalo to Massena

Two-unit one-boiler-per-turbine plant ready for upstate New York defense load. Compressed-air soot blowing, speed-reducer couplings in auxiliary drives, pilot operation of safety valves and premeasured combustion control feature design *

▶ RELIABILITY of modern boilers, a simple station design, and a combination of lowest capital, maintenance and operating costs led to selection of the single boiler-turbine arrangement at Oswego. The first 80,000-kw single-cylinder, 1800-rpm turbine and its 900,000-lb-per-hr, 1250-lb, 900-F boiler were placed in service in December, 1940, the second similar unit started August, 1941. A third is scheduled for installation in 1942 in the Charles R Huntley station of the Buffalo-Niagara Electric Co, located at Buffalo, N. Y., and interconnected electrically with Oswego.

Because two-thirds of the generation of the Niagara Hudson system is hydro, Oswego has been built for maximum flexibility of operation. Turbines can carry minimum loads of 4000 kw on standby or turn out 100,000 kw at times of low flow at the hydro plants. The generator can be readily disconnected from the turbine for operation as a synchronous condenser. For starting the latter, the 300-kw direct-connected exciter supplies accelerating power, taking its dc supply from a 500-kw motor-generator set.

The six bleed points of the single-cylinder turbine supply three direct-

* Condensed from a paper presented by N R Gibson and H M Cushing of the Niagara Hudson Power Corp before the annual meeting of the American Society of Mechanical Engineers, Dec. 1941.

contact and three surface heaters. Two independent constant-speed motor-driven condensate pumps are each built in three sections within a common shell. One pump is normally in service, the other a standby. The first heater, taking steam from the 14th stage of the 17-stage turbine, is a jet-type unit. The 12th-stage heater is a tray unit and the 9th-stage effects deaeration. As shown in Fig. 5, the condensate also picks up heat from inter- and after-condensers of the air-removal equipment and from the lubricating-oil and hydrogen coolers.

Auxiliary power, something less than 6% of gross generation, comes from station service transformers; no auxiliaries are steam driven.

All motors over 150 hp are supplied at 2400 volts, smaller drives at 575 volts. All auxiliary service is supplied by at least two sources, that is, two fans of each type, two circulators, two hotwell pumps, etc.

The 58,000-sq-ft surface condensers have 7/8-in. diameter admiralty tubes 29 ft 8 in. long. The four sections of shop-welded condenser shell were bolted together in the field. Cast-iron water boxes have vertical partitions to allow cleaning one side with the turbine operating at reduced output. A sectionalizing gate valve between each circulator and the condenser makes possible supplying both sides of the condenser from either pump at light loads. Steam for air ejectors is throttled to 225 lb from 1250 lb. main steam supply pressure.

Hydraulic Pump Couplings

Three 550,000-lb-per-hr 8-stage 3600-rpm, and one 220,000-lb-per-hr 9-stage 3600 rpm boiler-feed pumps supply each boiler. Each of the large pumps is driven by a constant-speed 1800-rpm induction motor through a variable-speed hydraulic coupling and a 1 to 2 step-up herringbone gear. The smaller pump, for light loads, is driven at constant speed by a 3600-rpm motor.

Boiler-feed piping is welded throughout, as is the carbon-moly main steam line. Pump speed is held at the minimum required to maintain desired excess pressure across the 3-element feedwater-control valve. The share of the total flow carried by any pump is regulated automatically and may be the same or different from that of the other pumps under control of the operators. The automatic control also opens a bypass at low flows to avoid overheating the pump.

With a furnace heat release of one billion Btu per hr. the radiant steam generator has a 66-in. diameter top drum and a 30-in. bottom drum. Primary and secondary sections of the fur-

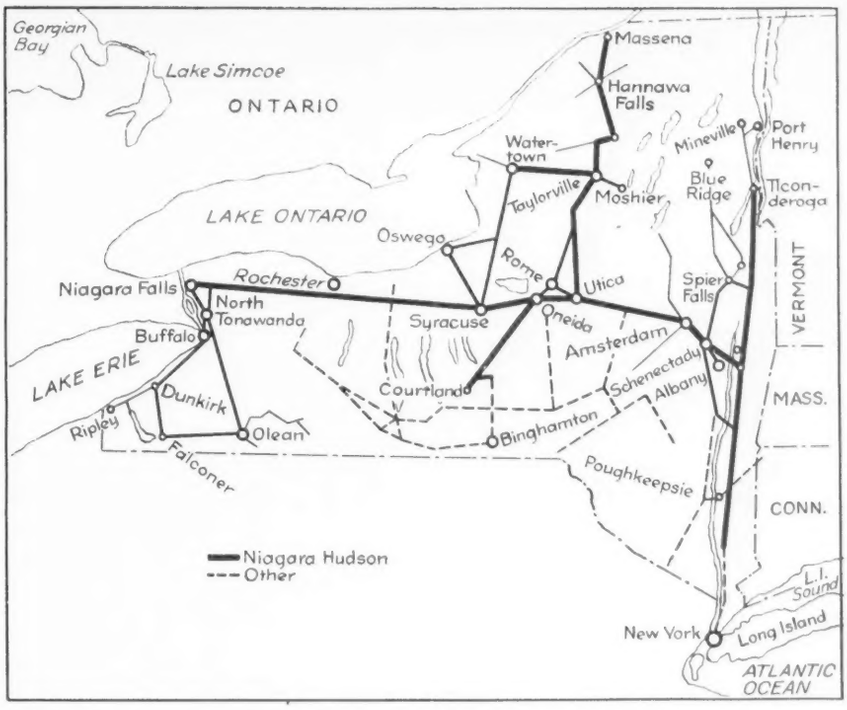


Fig. 2—Interconnecting ties of the Niagara Hudson System link new Oswego power to Niagara, New York City and Massena, aluminum-production center

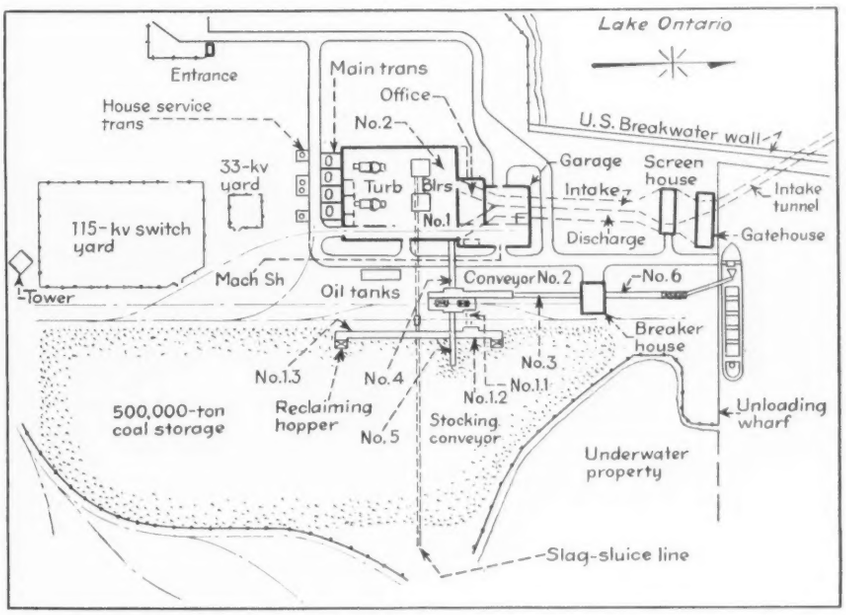


Fig. 3—Diesel bulldozers handle coal storage; slagsluice provides fill for underwater property; circulators can be reversed to meet storm and ice conditions

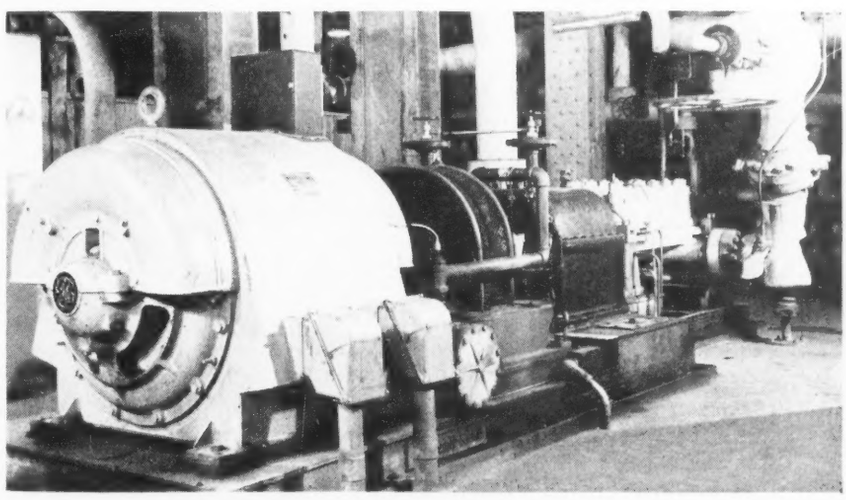


Fig. 4—Hydraulic coupling and herringbone gear drive 3600-rpm boiler-feed pump

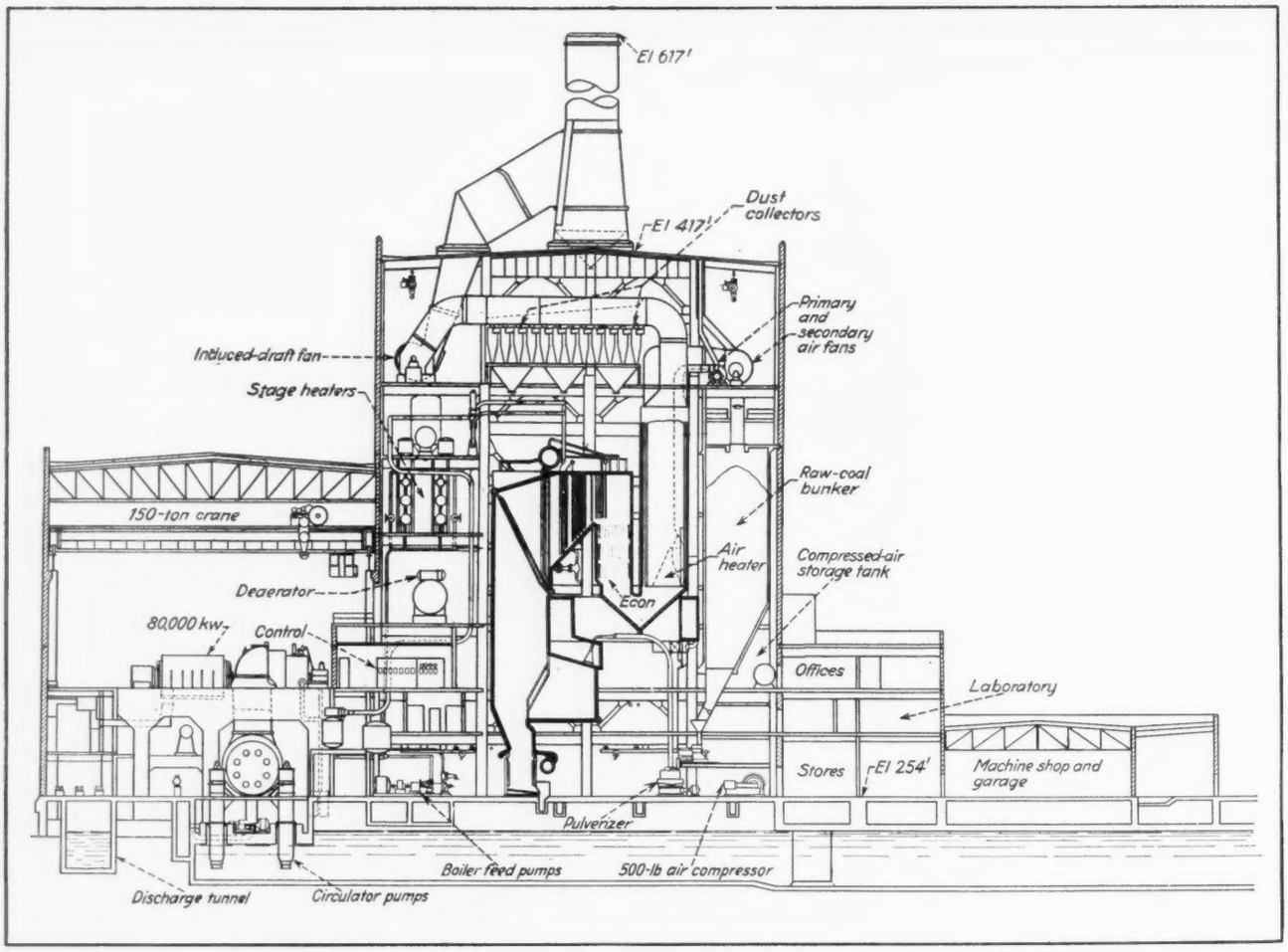


Fig. 5—One 900,000-lb-per-hr boiler supplies each 80,000-kw unit. Multicyclone dust collectors clean flue gas ahead of induced-draft fan and all-welded stack. Circulating-water tunnel construction provides for recirculation or backflow

nace are followed by two non-draining superheaters, a steaming economizer and two tubular air heaters. The steam drum is equipped with cyclone separators for elimination of moisture from outgoing steam.

The most highly prized accessories to the pulverized-coal firing equipment are the fuel-oil lighters. The push of an electric button on the boiler panel starts the fuel-oil pump. Oil pressure injects the lighter into the furnace and an electric spark ignites the oil. Within seconds a fat oil flame is burning beneath each burner, resulting in positive ignition of pulverized coal. These lighters are used each time a new burner is brought into service whether or not there is a coal flame in the furnace from other burners.

Special metering equipment has been provided to indicate and record the condition of feedwater, boiler water and flue gas. Ohmmeters give conductivity of condensate from main and evaporator condensers. Steam purity is measured in micromhos entering and leaving the superheater. Hydrogen emission is measured from a condensed and degasified steam sample. Percentage of oxygen in flue gas is measured directly and recorded continuously on boiler panel.

All drum and superheater safety valves are provided with actuating cylinders which enable the valves to be popped by air from a centrally located control station on the operating floor or by steam from pilot safety valves. The latter are located at the turbine-stop valve as well as boiler drum and can be isolated for maintenance by gate valves, as the main valves meet code requirements. This scheme provides sharp opening and closing of main valves by taking most of the wear on small valves that are easier and less expensive to repair. It also affords more effective protection to the superheater and turbine while reducing boiler outage for safety-valve repair.

Compressed-Air Soot Blowing

Soot blowing by 250-lb air takes no more energy from the coal pile than blowing with steam and in addition takes no water from the boiler. Air lends itself admirably to automatic control and eliminates expansion and warming up problems of steam-soot-blower piping. Two 500-cfm, 500-lb compressors with storage tanks and pressure-reducing valves supply a 250-lb tank from which the air for blowing is obtained.

Soot-blower units are automatically programmed in sequence for definite periods without attention from the operator. Heating surfaces are zoned so that normal heat absorption can be maintained in each by proper blowing frequency. Mass-blowing nozzles give greater bank penetration without need for accurate alignment of nozzles with tube lanes. Retracting units are installed in hot zones. Intermittent blowing of traveling-frame air-heater nozzles saves air and avoids impingement on tube sheets.

Telescopic blowers are projected into the boiler at twice the retracting or normal cleaning speed to save 25% of the air that would be required for a complete cycle at normal speed. No blower can start operation unless air pressure is correct. An alarm system indicates overload of motors connected with the automatic equipment and air-control valves of telescopic blowers have electrically operated latches to prevent their closing should current fail. This assures air for the blowers until receiv-

Principal Power Plant Equipment—Units 1 and 2

Oswego Steam Station, Niagara Hudson Power Corp

Coal and Ash Handling:

Belt-conveying equipment.....Stephens-Adamson Mfg Co
Coal received in hopper-bottom railroad cars and 4000-ton self-unloading freighters. Storage capacity, 500,000 tons. Transport 600 tons per hr on 42-in. belts into or out of storage. Complete with lump breakers and pan conveyors under reclaiming hoppers. Automatic sampler with Redler conveyor, also a Knittle crusher
Herringbone-gear speed reducers.....Farrel-Birmingham Co
Belts, canvas, rubber lined, 6 ply, 32 oz, 42 in.....Hewitt Rubber Co
Weightometer, with 3 delivery registers. .....Merrick Scale Mfg Co
Bradford-hammermill, 12 x 19 ft.....Pennsylvania Crusher Co
Tractors, Caterpillar diesel, 3, model D-8-98-hp..Syracuse Supply Co
With model CK-8 LeTourneau angle dozers, 2 carryall scrapers

Boilers and Furnaces:

Boilers, 2, each 900,000 lb per hr at 1320 lb..Babcock & Wilcox Co
66-in. upper drum, 30-in. lower drum. 7307 sq ft boiler htg surf, 9779 sq ft furnace walls. 43,520 cu ft furnace vol. Pendant-type superheaters, 12,650 sq ft. Steaming economizers, 26,900 sq ft. Tubular air preheaters, 2 per blr, 237,750 sq ft.
Superheater refractory side walls.....M W Detrick Co
Boiler and furnace heat insulation.....Johns-Manville
Smoke breechings and ducts.....Connery Construction Co
Stacks, steel, all-welded, 200-ft high.....Chicago Bridge & Iron Co
Stack linings.....Cement Gun Co
Gage glasses, Bi-color.....Diamond Power Specialty Corp
Three-element feedwater control of drum level....Bailey Meter Co
Soot blowers, air, preselected.....Diamond Power Specialty Corp
Pulverizers, 8, 12.5 tons per hr.....Babcock & Wilcox Co
Raw-coal feeders, 8.....Babcock & Wilcox Co
Coal-feed drives, 10-1 variable-speed motors.....Louis Allis Co
Induced-draft, secondary-, and primary-air fans....Buffalo Forge Co
Couplings, 12, variable speed, for fan drives.....Dynamatic Corp
Hydrojet system of dust removal.....Allen-Sherman-Hoff Co
Including slag hoppers and slag-handling equipment
Coal hoppers, extensions to bunkers.....Chicago Bridge & Iron Co
Valves in raw-coal spouts.....Stock Engineering Co
Water-conditioning system, 2 stage hot process.....Cochrane Corp
With integral deaerating heaters arranged for phosphate feed
Evaporators, 2, with condensers, 30,000 lb per hr..Griscom-Russell Co
Heat exchangers for evaporators.....Alberger Heater Co

Turbines and Auxiliaries:

Turbine-generators, 2, 80,000 kw, 0.8 pf.....General Electric Co
Single-cylinder, 17 stage, 1250 lb, 900 F, 3 phase, 60 cycle, 13.8 kv, with 1½-rpm turning gear and hydrogen cooling for generator, 300-kw, 250-v direct-driven exciter and 4-kw pilot exciter
Condensers, 2, single-pass steel-shell Worthington Pump & Mach Corp
Mounted on springs and bolted solid to turbine exhaust, 58,600 sq ft, 7/8-in. od admiralty tubes, divided water boxes, air-removal equipment
Direct-contact heaters with vent condensers....Foster Wheeler Corp
Heaters, high-pressure, horizontal, with subcoolers.Griscom-Russell Co
Coolers, for synchronous-condenser operation.....Ross Heater Corp

Pumps:

Vertical-shaft circulators, 59,000 gpm..Worthington Pump & Mach Co
Condensate pumps, 3-section.....Foster Wheeler Corp
Boiler feed pumps, split casing, 3600 rpm.....Ingersoll-Rand Co
Gears, herringbone one-two step up.....Turbine Equipment Co
Hydraulic couplings, 1750 hp, 1800 rpm.....American Blower Corp
Boiler-feed pumps, 220,000 lb per hr, 9 stage.....Ingersoll-Rand Co
Slag-handling pumps, 1000 gpm, V-belt drive..Allen-Sherman-Hoff Co
Slag-sluicing pumps, 750 gpm .....Buffalo Pumps, Inc
House-service pumps, 750 gpm, 200 ft head....Morris Machine Works
Low-service pumps, 3, 1200 gpm, 115 ft head..Morris Machine Works
Raw-water cooler pumps, 2, 1700 gpm.....Morris Machine Works
Condensate-circulator pumps, 4, 700 gpm.....Ingersoll-Rand Co
Screen-washing, 2, 350 gpm.....Worthington Pump & Mach Corp
Sump pumps for hotwell pit, 2, 300 gpm.....Buffalo Pumps, Inc
Evaporator-condenser pumps, 2, 150 gpm.....Ingersoll-Rand Co
Rotary arochlor pumps, 2.....Worthington Pump & Mach Corp
Rotary fuel-oil pumps, 2.....Worthington Pump & Mach Corp
Sump pumps, 7, 60 gpm, 15 ft head.....Taber Pump Co
Also 3, 30 gpm, 30 ft head and 1, 30 gpm, 15 ft head
Sewage sump pumps, 2, 7½ hp.....Yoemans Brothers Co

Air Compressors:

Cross-compound, 4, 500 cfm, 500 lb.....Ingersoll-Rand Co
Direct connected to 200-hp synchronous motors
Carbon ring, 3, 125 cfm, 100 lb.....Worthington Pump & Mach Corp

Piping and Valves:

Steam and condensate piping.....M W Kellogg Co
High-pressure steam, carbon steel, 0.5 moly, all welded. Also high- and low-pressure condensate piping
Circulating-water piping, cast iron....Wetherly Foundry & Mach Co
Traps, high-pressure.....Atwood & Morrill Co
Traps, low-pressure.....Strong, Carlisle & Hammond Co; Wright-Austin Co
Strainers.....Andale Co; Elliott Co
Bleeder non-return valves.....Atwood & Morrill Co
Blowdown valves, tandem assembly.....Yarnall-Waring Co
Boiler non-return angle-stop valves.....Schutte & Koerting Co
Check valves, tilting disk.....Chapman Valve Mfg Co
Chemical-feed pumps to boilers.....Hills-McCanna Co
Circulating-water gate valves, 48-in .....Rensselaer Valve Co
Forged-steel valves.....Henry Vogt Mach Co
Foot valves.....Buffalo Pumps, Inc
Gate valves for high pressure steam, feedwater...William Powell Co
Globe valves, 2, 8-in., 2000-lb, motor operated....William Powell Co
Globe and gate valves for hp steam and misc.....Lunkenheimer Co
Relief valves for water.....Crosby Steam Gage & Valve Co
Safety valves.....Crosby Steam Gage & Valve Co
With actuating cylinders and pilot-actuator safety valves
Drainer valves, pilot-operated float-controlled.....Bailey Meter Co
Heat insulation for pipes and ducts.....Union Asbestos & Rubber Co
Rubber expansion joints.....U. S. Rubber Co

Meters and Controls:

Remote-operated coal-burner lighters.....Babcock & Wilcox Co
Automatic combustion control, premeasuring type..Bailey Meter Co
Also automatic superheater-temperature control, water-level, hydrogen-temperature and condensate-flow controls
Soot-blower preselecting-program panel.....Autocall Co
Manometers .....Meriam Co
Degasifier for hydrogen-in-steam detector.....Cochrane Corp
Recording ohmmeters.....Esterline-Angus Co
Turbine supervisory instruments.....General Electric Co
Conductivity recorder.....Leeds & Northrup Co
Boiler and turbine control panels.....Bailey Meter Co

Electrical Equipment:

Transformers.....General Electric Co
Main generator, 4, 50,000 kva (66,667 fan-cooled) 13.2/115 kv, 60 cycle. Auxiliary, 2, 7500 kva (10,000 fan-cooled), 2, 3750 kva, (5,000 fan-cooled), pyranol auxiliary, 4, 1000 kva, (1250 fan-cooled)
Lightning arresters.....General Electric Co
Oil circuit breakers, 33 and 115 kv....Westinghouse Elec & Mfg Co
Outdoor disconnect switches, 33 and 115 kv.Hi-Voltage Equipment Co
Control and relay boards.....General Electric Co
Automatic frequency control, generator voltage regulator
Auxiliary power boards, 575 and 2300-v.....I T E Circuit Breaker Co; General Electric Co
Battery-charging motor-generator set, 250-v....Electric Products Co
Storage battery, 250-v, 480-amp-hr.....Gould Battery Co
Motors, 575 and 2300-v.....General Electric Co
Motor-generator sets, 300 and 500 kw.....General Electric Co
Motor-operators for valves, Limitorque....Philadelphia Gear Works

Miscellaneous:

Oil storage and purifying equipment.....Turbine Equipment Co
Elevator, 6000-lb, 100 fpm.....Otis Elevator Co
Elevator, passenger, 2500-lb, 200 fpm..Westinghouse Elec & Mfg Co
Stairways and platforms.....Syracuse Stair & Iron Works
Structural steel for powerhouse building.....Bethlehem Steel Co
Steel for coal galleries and switchyard...Lackawanna Steel Const Co
Traveling water screens.....Chain Belt Co
Turbine-room crane, 150 ton.....Shepard Niles Crane & Hoist Corp
Flue-dust catchers, multicyclone.....Prat-Daniel Corp
Heating boilers, 2, 1000 sq ft, 125 lb.....Ames Iron Works
Chemical laboratory furniture.....Kewaunee Mfg Co
Coal-grindability machine.....Babcock & Wilcox Co
Machine-shop crane, 15 ton.....Shaw-Box Crane & Hoist Co
Gatehouse crane, 15 ton.....Shepard Niles Crane & Hoist Corp
Hoist for fan floor, 7½ ton.....Shepard Niles Crane & Hoist Corp
Transfer cranes and hoists, 2, 5 ton.....Chisholm-Moore Corp
Welded surge tank for 29.5-in. vacuum....Chicago Bridge & Iron Co
Thearle portable dynamic-balancing equipment..General Electric Co
Mill-seal blowers, 2, D-4.....Allen Billmyre Corp

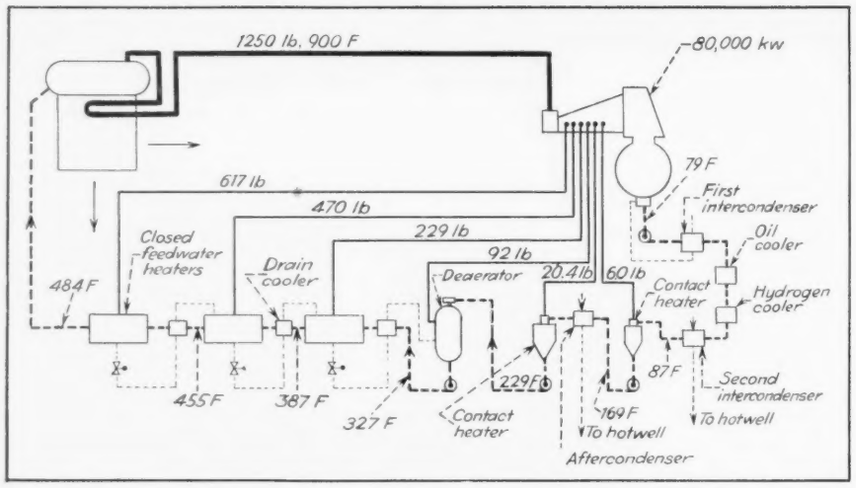


Fig. 6—Six stages of feedwater heating to 480 F with drain coolers and heat exchangers show a heat rate better than 11,000 Btu per net kwhr even at loads up to 100,000 kw per turbine. System of direct-contact heaters uses multi-casing condensate pump

ers are exhausted. When current is restored, blowers automatically return to retracted position even though moving forward when current failed.

Premeasured combustion control has been modified to increase speed of response for rapid load changes. Fans and raw-coal feeders are individually driven by constant-speed motors through variable-speed eddy-current couplings. Coupling speed is controlled by a built-in governor the setting of which is positioned by a pneumatic drive unit. Primary and secondary air are proportioned to measured coal flow by the pneumatically actuated combustion-control system. Fuel-air ratio is maintained at the proper value for each pulverizer and burner combination.

Eddy-current couplings require no large quantities of oil and give speed reductions up to 90% by simple governing means. Response is practically instantaneous and an infinite number of speed points are available. Heat generated is dissipated by the fan action of the coupling itself. At maximum speed the coupling slip is 2.5% and excitation power amounts to 2.5 kw.

Other automatic controls regulate water levels in the high-pressure heaters and hotwells of the main and evaporator condensers. For the main condenser, an air-operated valve also admits water from the open condensate-storage tank in event of low water.

Superheat temperature at the turbine throttle is controlled by a 2-element pneumatic unit which actuates a damper in the gas bypass around the superheater. Generator hydrogen is normally cooled by heat exchangers in the generator frame, but if condensate cooling is insufficient for any cause a temperature control positions a butterfly valve in the raw-water supply to a special heat exchanger always in the condensate circuit ahead of the hydrogen coolers.

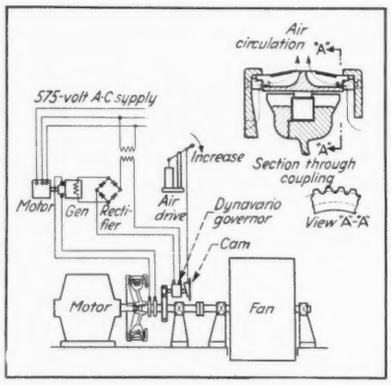


Fig. 7—Full range of speed adjustment of 1250-hp induced-draft fans is provided by eddy-current couplings. Similar couplings also regulate speed of primary- and secondary-air fans

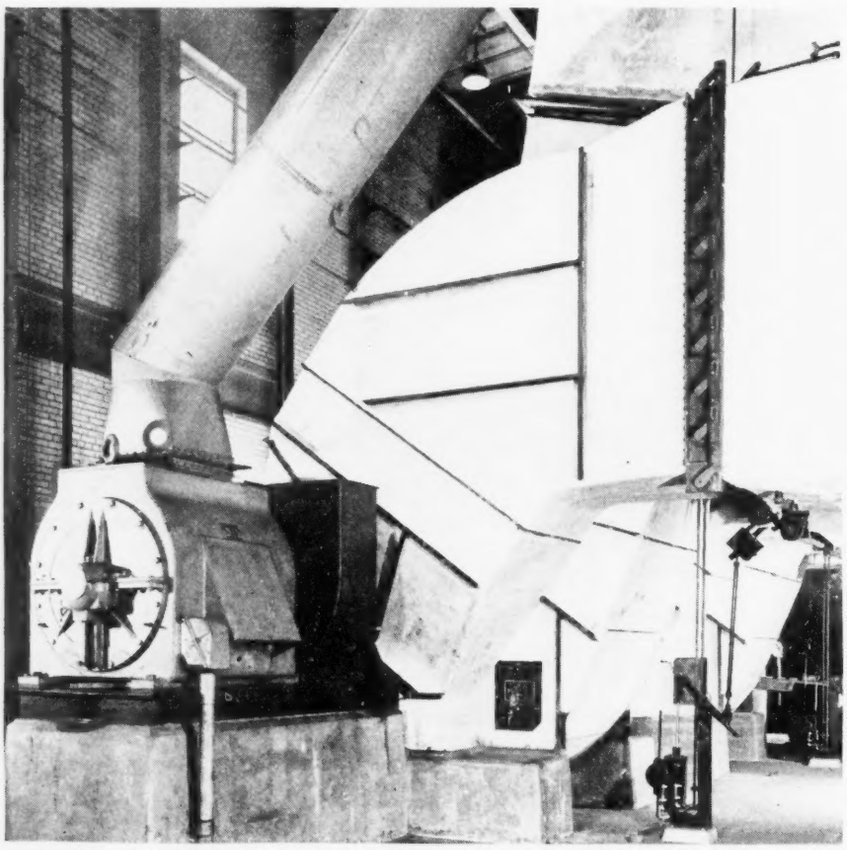


Fig. 8—Eddy-current coupling provides speed control of induced-draft fan

Protection against fire is provided by fixed water-spray systems for all oil-filled transformers, the oil-filled hydraulic couplings in the boiler feed pumps, turbine-oil tanks and piping, turbine-oil storage room, oil-treating equipment, repair pit in the turbine room and the coal-handling conveyor galleries. Some of these systems are automatic in operation while others are manual.

Fixed hose racks and hose lines with adjustable spray nozzles are provided throughout in an arrangement whereby any fire can be fought simultaneously by two hose lines. Houses near outdoor switching structures contain hose lines with "poweron" nozzles as well as CO_2 and carbon-tetrachloride portable equipment. Portable devices of various types and sizes, including large foam generators, are strategically located throughout the property.

Know Your Pump-Motor Controls

H W Costello, application engineer, Cutler-Hammer, Inc, reaches back into his many years of experience with electric-motor control and gives us a lot of helpful pointers on the selection and application of pump-motor-control equipment

▶ CONTROLS FOR PUMP MOTORS may be divided roughly into two groups: for motors driving pumps discharging into open tanks and for motors driving pumps discharging into closed tanks. The first group is by far the larger and will be considered in this article.

The term "open tanks" implies tanks open to atmospheric pressure and includes supply tanks to be kept filled and sumps to be kept drained. Both use float switches or the equivalent to maintain water level. On the pumping units considered here the float switch acts only as a pilot device in the same sense as a pushbutton, in contrast to small pumping units where the float switch can handle the motor current directly.

The simplest form of a controller is that for across-the-line starting of squirrel-cage motors. Minimum requirements on such an application are a float switch, magnetic contactor, overload relay, line switch and fuses or circuit breaker and a 3-way operator switch.

Fig. 2 shows a float switch without accessories which can be connected either single-pole, double-break, or 2-pole single-break for pilot service. Contacts are quick make and break, and the enclosure is splashproof. All operating parts, both copper and steel punchings, are plated to resist corrosion. The float rod connects at *A* and *A* and the switch is closed by the float pulling levers *L* down as water level drops and is opened by the float pushing them up as the water level rises. There are five standard mounting arrangements for float switches: Clamping over edge of tank using a float rod; floor pedestal using a float rod; switch mounted on outside of tank with switch shaft operated by float and rod extended through wall of tank; floor pedestal, float, chain and counterweight; and float switch mounted on wall remote from tank and operated by float, chain and counterweight.

Standard copper floats are designed for water at temperature below 110 F. For hot water a special seamless float is used. Floats are usually about 7.5 in. in diameter and are from 12 to 18 in. long and develop a force between 4 and 5 lb. Reliable switch operation can be obtained by float movements as small as 6 in., there being no limit on the maximum float movement. Standard commercial float rods are 5 ft long, but special rods up to 35 ft are listed as standard. Float switches should be mounted so that float movement will not be affected by the incoming water when the tank is filling.

Standard magnetic contactors for

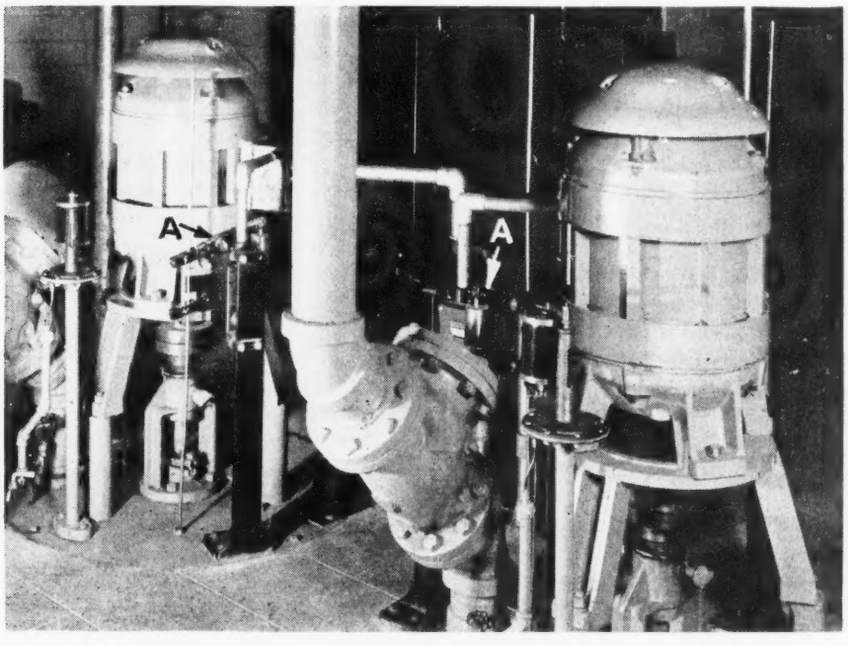


Fig. 1—On pumping units float switches at *A* act only as pilot devices to close or open the control circuit to start or stop the pump motors

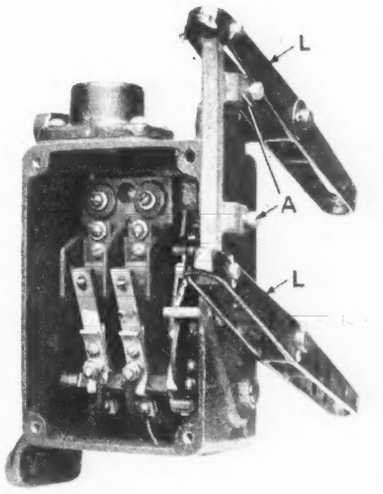


Fig. 2—Two-pole-switch contacts may be connected in parallel or series

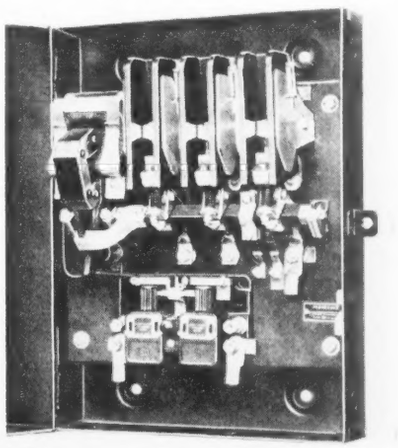


Fig. 3—Three-pole across-the-line automatic starter for squirrel-cage motors

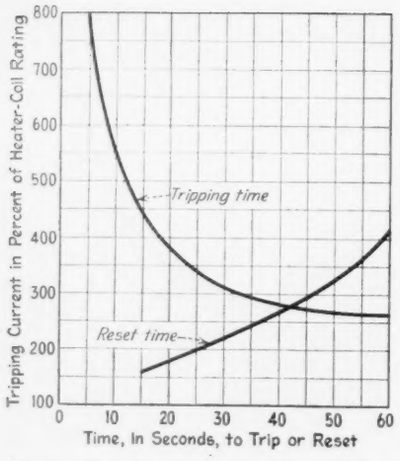


Fig. 4—Tripping and reset times of thermal overload relays

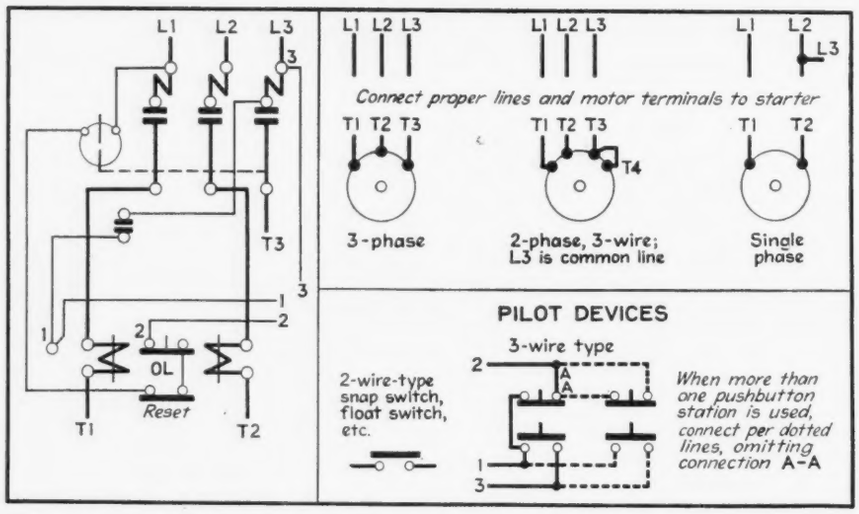


Fig. 5—Conventional diagrams for a magnetic starter, such as used for automatic control of pump motors, consisting of a contactor and an overload relay

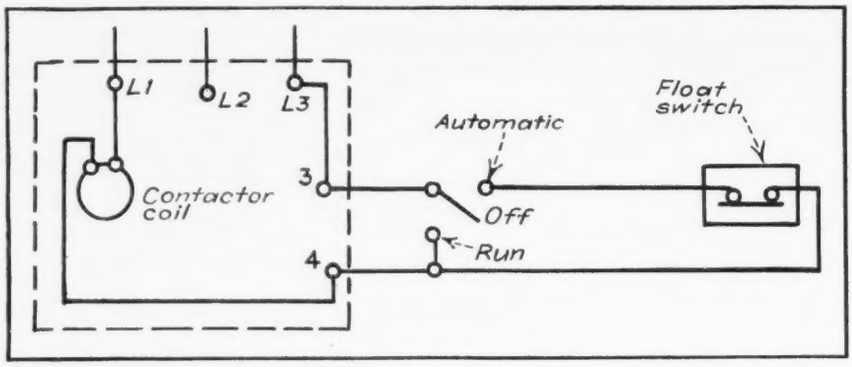


Fig. 6—Connections for the 3-wire pilot switch, Fig. 7, permit starting and stopping the pump motor independent of the float switch

across-the-line starting of squirrel-cage motors come complete with the overload relays mounted in an enclosure as in Fig. 3. Magnetic contactors follow standard ratings set by the National Electrical Manufacturers Association (NEMA), as given in the table. Magnetic contactors must carry safely full starting current of squirrel-cage motors on full-voltage starting, which is normally six times full-load rating, but which may reach eight times. Contractors approved by the Underwriters' Laboratories have been tested to make and break ten times their nominal rating and are designed by control manufacturers to meet these requirements for thousands of operations with only nominal maintenance. On these contactors the coil is designed to pull in on 80% of rated line voltage and to operate without hum and overheating on voltages 10% above nominal.

On these controllers the thermal overload relay has two elements (duplex type), one of which is in line L_1 and the other in line L_2 of the 3-phase circuit to give full overload protection of all three phases. On the stalled current of a standard general-purpose squirrel-cage motor, the relay will trip out in about 20 sec or less, but may take as much as two hours to trip out on a light overload condition. Fig. 4 is a performance curve showing the tripping time corresponding to the percent of normal motor current and the reset time.

For example, at 300% full-load current of the motor, the relay will trip in about 32 sec. In about 47 sec afterward the low-melting-point alloy will have cooled to where the relay can be closed and will remain in that position. At 400% full-load current the relay will trip in about 18 sec and can be closed after about 60 sec. The higher the overload current the hotter the relay gets before it trips and the longer time required for the alloy to cool so that the relay will be held closed.

STANDARD NEMA RATINGS FOR MAGNETIC CONTACTORS

NEMA size contactor	*Ampere rating*	*Hp 220 v*	*Hp 440 v*
1	25	5	7.5
2	50	15	25
3	100	30	50
4	150	50	100
5	300	100	200

Experience has shown that an overload relay proves most valuable when putting the equipment into service. If a relay trips out it shows that there is something wrong outside the controller. It cannot be emphasized too strongly that tripping of an overload relay should not be taken as an indication that the controller is not functioning properly. Too frequently on new installations it is assumed that a controller is giving trouble when the relay trips out and shuts down a pump. This, however, is a sign that the controller is doing its job and would be faulty if it failed to trip out. Bypassing the heater coils defeats the purpose of the overload relays. Proper procedure is to find the cause for the relay tripping out.

Fig. 5 shows a conventional diagram for a magnetic starter consisting of contactor and overload relay just described. Some of the symbols used in this diagram are arbitrary but the majority of them have been adopted by NEMA. Where a float switch or similar 2-wire pilot-control device is used, it is desirable to provide for starting and stopping the motor independent of the float switch. To be able to do this is particularly desirable during installation when adjustments are being made. The expression "2-wire control," is a NEMA convention, and in the standard diagram, Fig. 5, connections are shown for both 3-wire pushbutton control and for 2-wire control devices. A float switch is a typical 2-wire control device.

For 2-wire float-switch control, only terminals No. 2 and 3 on the diagram, Fig. 5, are used, which gives no-voltage release. Standard-line starters have three terminals, No. 1, 2 and 3 in the control circuit. All three terminals are used for 3-wire control devices like a 2-button "start" and "stop" station. A pushbutton station of this type is never

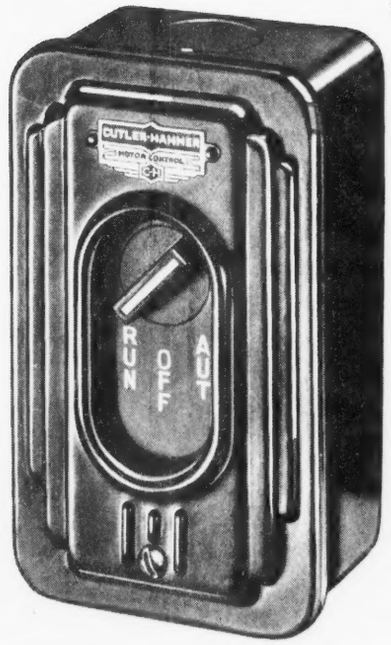


Fig. 7—Three-position pilot switch that is connected into circuit, as in Fig. 6

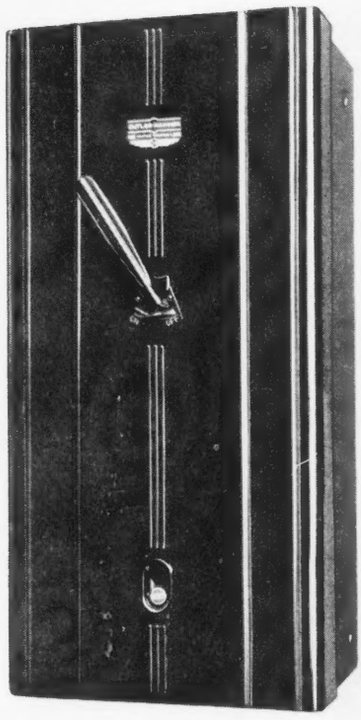


Fig. 8 Enclosing case for the 3-wire across-the-line automatic starter, Fig. 9

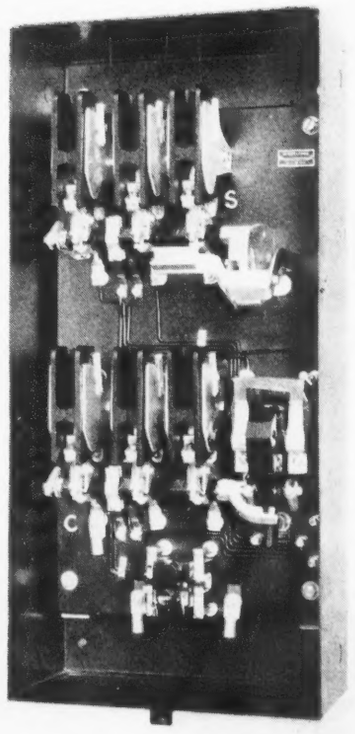


Fig. 9—Starter with contactor-type line switch and magnetic starting contactor

used for a motor float-switch control.

No-voltage release obtained by 2-wire control means that the starter will drop out if voltage fails for any reason, but the starter will immediately reclose when voltage returns, if the float switch is closed. On the other hand, 3-wire control gives no-voltage protection. That is, when voltage fails the starter contactor remains in the open position and will not close after voltage is re-established until the operator presses the start pushbutton. On a 3-phase system, it is established practice to take the control circuit from lines L_1 to L_3.

A 3-wire pilot device is usually provided to make it possible to start and stop the pump independent of the float switch. One of the pilot devices is shown in Fig. 7. The middle position opens the control circuit so that the motor cannot be started. The position on the right is marked "automatic" and indicates that when the switch is closed to this position the motor is under float-switch control and automatically starts and stops depending upon the position of this switch. Turning the pilot switch to the left position, marked "run," the motor will run so long as the switch is left in that position. Fig. 6 shows the connections of this 3-way pilot device in the control circuit.

A pump-motor and control installation is not complete without provisions for branch-circuit protection as required by the National Board of Fire Underwriters. The most common form of protection is a fused safety switch. Fuses protect the wiring against abnormal conditions such as a short circuit. In addition to protecting the wiring against overloads, fuses will protect the controller because neither the contactor nor the overload relay are designed to protect the circuit against a short circuit. Where the circuits are fused in a central panel board the safety switch mounted ahead of the pump motor controller may be unfused.

A circuit breaker is often used instead of a fused safety switch. The National Board of Fire Underwriters recognizes a circuit breaker and a fused safety switch as giving the same degree of protection. No definite rule can be made for the selection of one in preference to the other. One consulting engineer arbitrarily specifies a fused safety switch for motors 10 hp and smaller and a circuit breaker for motors 15 hp and larger, but this is the practice of only one engineer.

Circuit breakers have no elements that require replacement after the circuit has been cleared. However, they have mechanical parts which must be inspected and maintained. Fuses must be replaced when blown while clearing a circuit, but require no mechanical maintenance like circuit breakers.

The disconnect switch serves to kill the circuit when it is necessary to maintain the motor or controller. It satisfies a clause in the National Electrical Code calling for a manual disconnect means within sight of the motor. Type A safety switches are both quick-make and quick-break. Their operating handle interlocks with the inclosing-box cover so that the switch must be open before the cover can be opened, to guard against accidents to the operator. Type C safety switches are also quick-make and quick-break, but the inclosing-box cover is not locked with the switch position.

Individual pieces of equipment that make up a complete controller have been discussed. Not so many years ago, all controllers were made up in that way, and probably the majority of them are still supplied that way today. The modern plan, however, is to have the contactor, the 3-position pilot switch, and the disconnect switch, all combined in one enclosure, Fig. 8.

Not only is such an arrangement neater in appearance, but it costs no more when the mounting and wiring costs are considered. In Fig. 9 the disconnect switch S is made up of the same parts as the magnetic contactor C, thereby simplifying and reducing to a minimum the number of different parts. A fused or unfused knife switch can also be used instead of the contactor-type switch, S. Disconnect switch S is quick-make and quick-break and is interlocked with the starter cover so that the switch must be opened dead before the cover can be opened.

X-Ray Fingerprints Scale Deposits

Finding out what boiler and turbine scales contain leads to better understanding of the conditions that led to their formation. The x-ray shows not only the presence of metallic elements but tells how large the crystals are and what combinations exist

By C E IMHOFF *and* L A BURKARDT
Allis-Chalmers Mfg Co

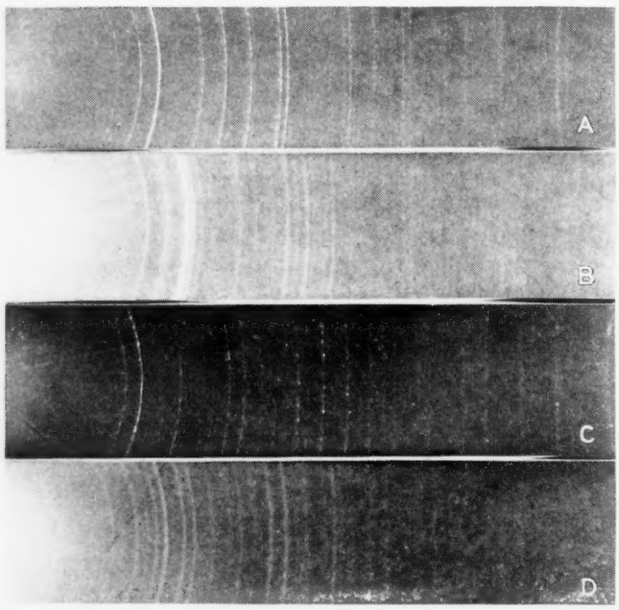


Fig. 1—Each crystalline deposit has its own characteristic x-ray pattern. Wherever and however formed, each compound exhibits the same lines. These are (a) calcium carbonate as calcite (b) calcium phosphate as hydroxylapatite (c) calcium sulphate as anhydrite and (d) calcium silicate as xonotlite

► HARD DEPOSITS on the heating surfaces of boilers, on turbine blades or in piping threaten interruption of power production. They lead to tube burnouts and reduced turbine capacity. Their formation indicates the existence of improper conditions in the water-steam cycle.

Full and complete analysis of both chemical and physical character of such deposits leads to accurate diagnosis of underlying causes. Analysis should include not only the chemical elements present but should also reveal their combinations, crystal form, particle size and crystal orientation.

Chemical analysis determines the elements present but the manner of their combination must be assumed. Compounds of the same elements vary in their formation at different conditions of temperature and pressure. The x-ray diffraction method of analysis gives positive identification of each crystalline compound.

Optical methods, useful in identifying natural minerals, have limited application to the examination of power-plant deposits, because the latter often have high opacity due to the presence of iron compounds and are of small particle size. X-ray diffraction can be applied to any crystalline material.

While a chemical analysis might show that a scale sample contains calcium, magnesium and carbon dioxide, the x-ray pattern would indicate the presence of calcium carbonate and magnesium hydroxide if these happened to be the combined forms in the scale. The existence of the latter compound can only be inferred from the chemical analysis but is definitely shown by the x-ray pattern.

In another instance, where the chemical analysis might show calcium, magnesium, silica and carbon dioxide, it might be inferred that the calcium and magnesium were combined with the silica and carbon dioxide. An x-ray analysis might, however, determine that the silica was present in the free state, the calcium combined as carbonate and the magnesium as hydroxide.

If the sample contains silica and alumina, it may be of advantage to determine if the complex sodium-aluminum silicate (analcite) is present. This cannot be done by chemical means but the characteristic analcite pattern shows up readily under the x-ray.

By giving definite information as to the state of combination of the elements present in a crystalline material, the x-ray analysis indicates the nature of the chemical reactions that have taken place to produce these compounds. In turn, such evidence suggests methods of counteracting such reactions.

The x-ray method also yields further information of value. Particle size of the crystals can be measured. Distribution of crystals, whether random or oriented in some preferred

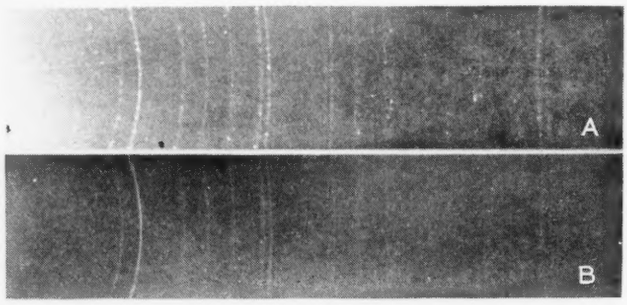


Fig. 2—Large-grained calcium carbonate (a) produces spotty lines while fine particles yield thin lines (b) also calcium carbonate. Materials of very small particle size show broad diffused lines so that particle size can be estimated by measuring breadth of diffraction

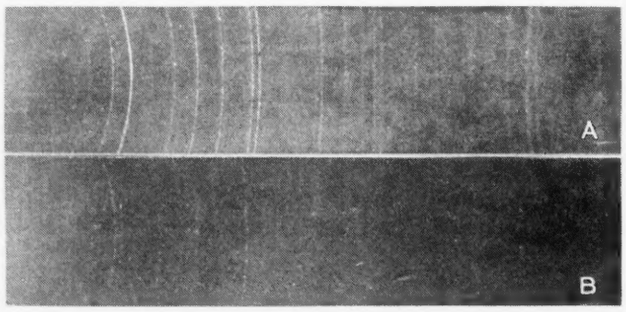


Fig. 3—Different crystalline forms of the same chemical compound produce different patterns and can be distinguished from each other. Where a chemical compound can exist in more than one crystalline phase such as calcium carbonate as (a) calcite and as (b) aragonite, the phase in which the deposit is found indicates the conditions under which the deposit was formed

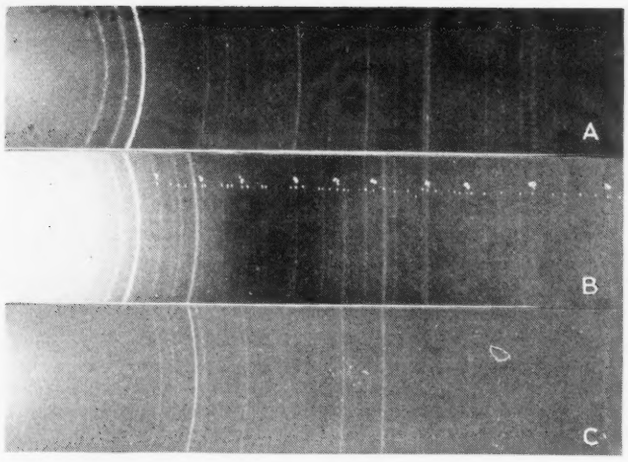


Fig. 4—Where two or more crystalline materials are present, the pattern of each appears in the pattern of the mixture. Both silicon dioxide as quartz (a) and iron oxide as magnetite (c) appear in the turbine deposit (b). The lines of (a) and (c) appear in (b) in corresponding position and intensity and thus allow identification of both materials

direction, offers further suggestion as to the history of the sample, the conditions of its formation and possible alterations that may have taken place after deposition. Interesting studies have been made comparing patterns of the tube and water side of the same scale sample to determine differences in composition.

Many chemical compounds exist in two or more crystalline forms. For instance, calcium carbonate has three forms. Anhydrous sodium sulphate has five forms, of which only two are stable at ordinary temperatures. Crystalline silica exists in six variations. The form a compound may take depends principally on the temperature at which it is formed. Hence the crystal modifications indicate conditions under which scale formed or to which the deposit was subjected, since changes in phase can occur after deposition.

Although the x-ray powder-diffraction method has been known since 1916, only in recent years has it been applied to industrial problems. Now, however, identification can be made because each chemical compound gives a characteristic pattern of lines at various distances from a focal center. The pattern of each compound is produced independently of any other compounds present. In a mixture, the pattern contains the individual lines of all components.

Unknown-compound patterns are compared with those of known materials. Matching the pattern lines is much like comparing fingerprints. A match of four or five lines in their proper order and intensity is sufficient to indicate the presence of a given compound.

An alternate procedure involves calculation of the interplanar distances represented by the lines of the pattern and comparing the series of numbers so obtained with those of

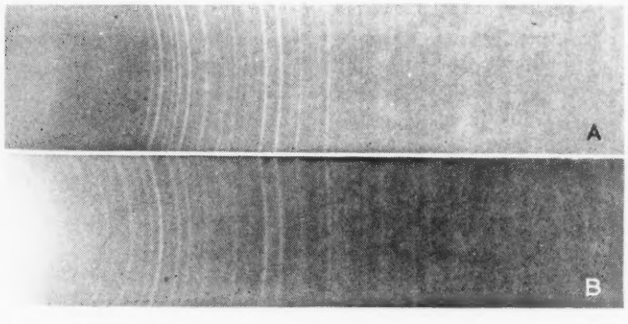


Fig. 8—The solid phase produced by phosphate reactions in hydroxylapatite (calcium phosphate) (b) matched by this scale sample (a) rather than tricalcium phosphate as thought

Fig. 9—Patterns of boiler scale (a) and calcium silicate as xonotlite* (b) show distinctly that the latter form is present rather than any of several other possible calcium silicates

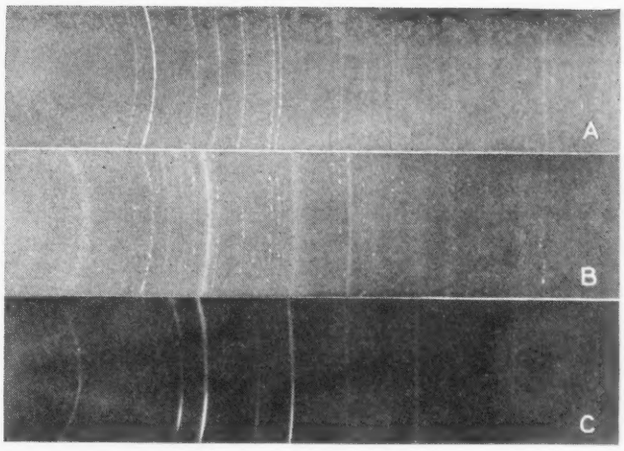


Fig. 5—In this mud-trap sample (b) the calcium carbonate (a) is coarse grained while the magnesium hydroxide (brucite) (c) is fine grained. Pattern (c) shows the lines more intense in one section due to a condition of particle alignment termed preferred orientation

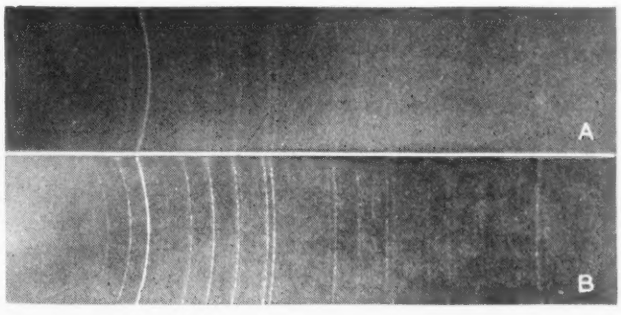


Fig. 6—The x-ray pattern for the scale sample (a) matches standard calcium carbonate (b) showing that the scale is practically 100% calcium carbonate. The evenness of the lines indicates uniform particle size and width of line says that size was small compared to (a)

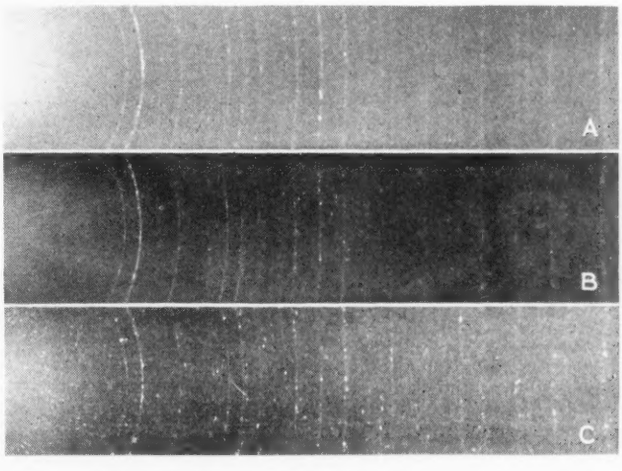
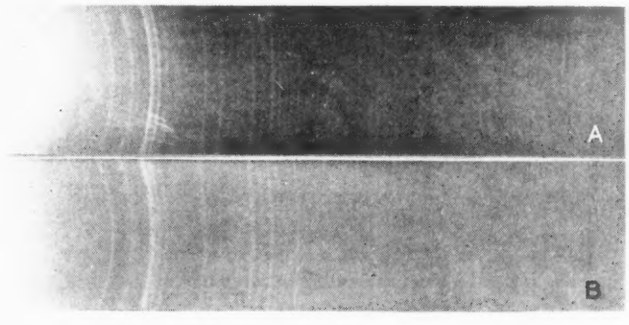


Fig. 7—Scale samples (a) and (c) are identical with standard calcium sulphate (b) as anhydrite but the speckled appearance indicates large particle size characteristic of calcium sulphate which grows in long needle-like crystals on hot metal surfaces



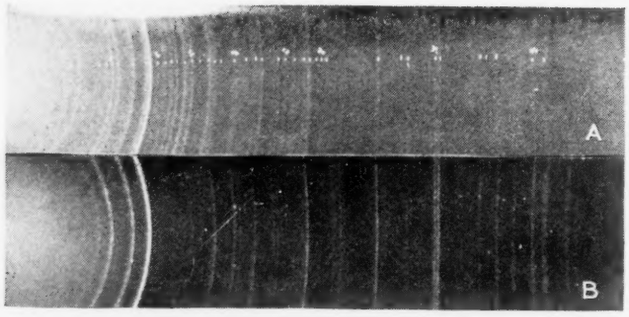


Fig. 10—Silica formed at low temperature as alpha quartz cannot be identified in a mixture of silicates by chemical methods but this scale sample (a) can be seen identical with the alpha quartz sample (b)

known compounds. For example, the first column in the table below lists the interplanar spacings of an unknown sample along with the similar data for calcite and anhydrite taken from previously published material.

Interplanar distance in unknown	*Interplanar distance in calcite*	*Interplanar distance in anhydrite*
3.88	3.86	3.89
3.50		3.49
3.05	3.04	
2.86		2.85
2.76		
2.53		
2.50	2.49	
2.32		2.32
2.29	2.28	
2.14		
2.10	2.09	
2.07		2.08
1.91	1.92	
1.88	1.87	
1.71		
1.62		
1.60	1.60	
1.52	1.51	
1.44	1.44	
1.35	1.35	
1.29	1.30	

It will be noted that all the main lines of the calcite and anhydrite patterns appear in the unknown, proving their presence in the sample. The remaining lines in the unknown not matched by either calcite or anhydrite are a minor impurity.

Some of the advantages of the x-ray analysis can be summarized briefly (1) the components of a material are identified in their combined forms (2) particle size is indicated (3) orientation or lack of it can be observed (4) a very small sample is sufficient (5) the sample is not destroyed in the analysis and other tests can be made (6) samples from various points can be studied to determine differences throughout a mass of material (7) the pattern obtained is permanent, always available for further study and comparison.

Fig. 1 is a comparison of the patterns of several common deposit-forming materials showing the differences in their x-ray patterns. Fig. 2 illustrates the changes that take place in the pattern lines with change of particle size. Change of particle size has no effect on the position of the lines but alters their appearance as shown. Fig. 3 shows that different crystalline phases of the same compound yield different x-ray patterns that can readily be distinguished from one another. Figs. 4 and 5 illustrate the analysis of a chemical compound mixture by comparison with patterns of known materials. The remaining patterns are examples of power-plant deposits alongside known compounds for comparison.

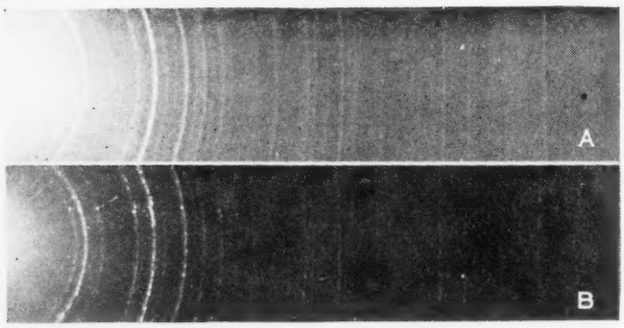


Fig. 11—The pattern of the scale sample (a) indicates that one of the main constituents is analcite (b) since the strongest lines match. Complex structures such as this cannot be identified chemically but can be readily found by the x-ray method.

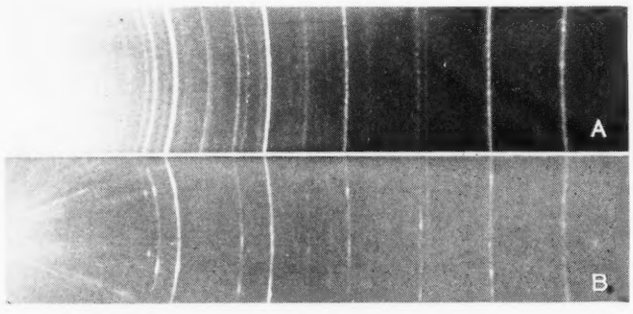


Fig. 12—The composition of turbine-blade deposits like (a) depends on temperature conditions under which they formed. Pattern (b) of sodium chloride identifies this deposit as common salt

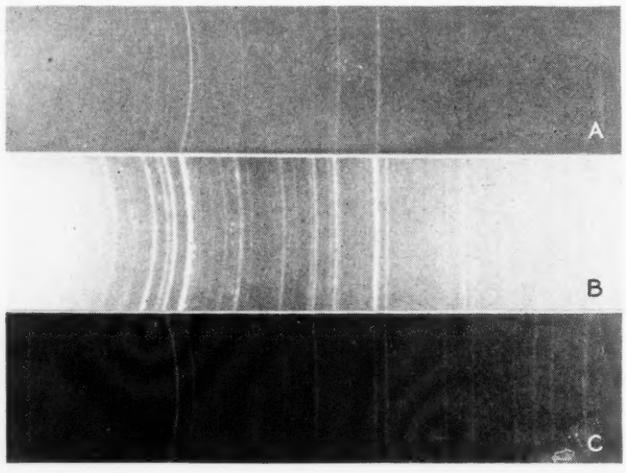


Fig. 13—Another turbine deposit (b) consists largely of a mixture of iron oxides, magnetite (a) and hematite (c). The former is the corrosion product found in high-temperature areas where the oxygen content is low; the latter is encountered where iron is more completely oxidized

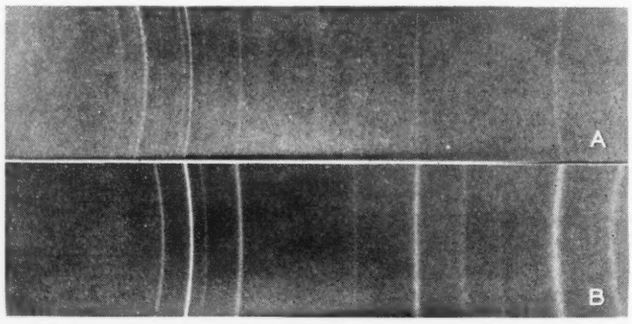


Fig. 14—The presence of metallic copper (b) in this pump deposit (a) is clearly indicated. The x-ray determines the presence of a metal accurately even though oxides of the same metal are present, difficult to establish by chemical means

Mobile Power Backs Up Navy Bases

Two railcar steam-electric plants will stand ready to supply emergency needs of East and West Coast establishments. W N Oberley, General Electric Co, describes design

▶ The Bureau of Yards and Docks, Navy Department, has ordered two 10,000-kilowatt mobile steam-electric power plants mounted on special railway cars from the General Electric Co to supply emergency power wherever its projects may require. The Bureau will locate one unit centrally on the West Coast and the other on the East Coast.

The "mobile" power plants will be the first of their kind to be built, but the turbine generators, boilers, and electrical equipment used in them will be apparatus of the types proved in service in regular central station and industrial installations.

Each of the units will be housed in two specially built railway cars which can be hauled over the rails at speeds up to 40 miles per hour.

The power-generating car will contain a 10,000-kw turbine-generator and its accessories, a condenser, and the necessary switchgear. The boiler and its auxiliaries, along with a starting engine generating set will be housed in the second car. A mobile substation constructed on a standard car, will be used in conjunction with each generating unit to permit proper voltage for any naval shore establishment.

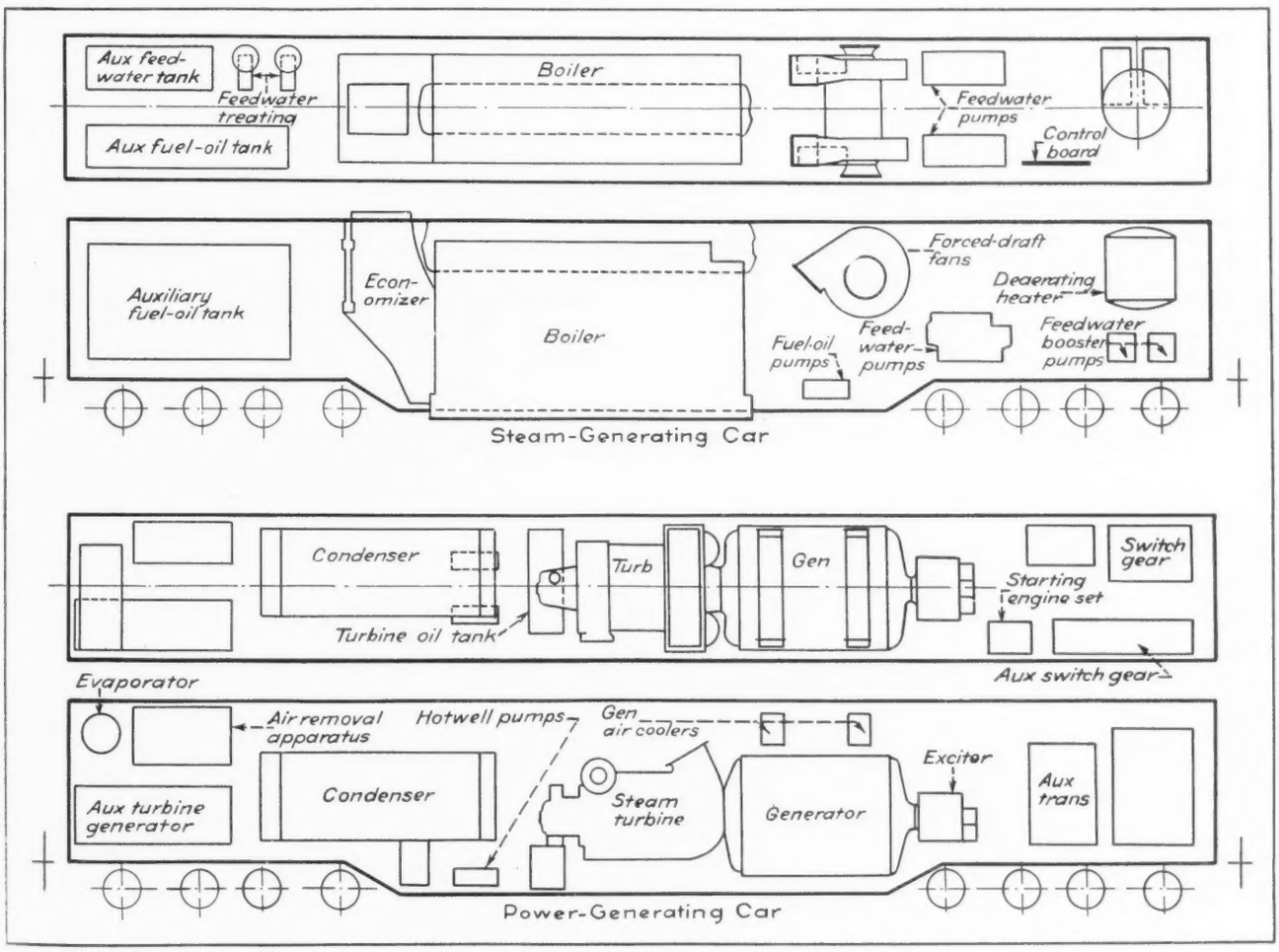
General Electric engineers estimate that the mobile power plants can be put "on the line" within 24 hours after they are shunted into a siding.

Bunker C fuel oil will be used to fire the boilers, and each unit will consume about three tank cars of oil a day when operating at full load. A sufficient fuel supply for two hours' operation will be carried in the boiler cars of each of the units, however, so that they can generate power before the tank cars are hauled up and connected.

The two specially designed cars of each unit will be duplicates. They will embody fabricated welded-steel girder construction of the drop-frame type. The total weight (about 200 tons) of each car will be carried on eight axles, thereby obtaining an axle loading within the limits of good railroad practice.

The natural-circulation-type boiler for each unit will furnish 140,000 lb of steam per hour. The turbines will be of single-cylinder design. They will be designed for 550-lb steam at 825 F.

The 3600-rpm generators will produce 60-cycle, 3-phase power at 13,800 volts. They will be forced-air cooled.



How to Judge Used Diesel Lube Oil

Contaminants accumulated in service cause rapid wear and breakdowns, if allowed to exceed proper limits. S S Hansen, chief lubrication engineer of General Petroleum Corp, shows how contaminants form in the oil, what they do to the engine, how they may be measured and how to use the tests to answer the question "When shall I change the oil?"

► SELECTING THE RIGHT TIME to change the lubricating oil plays a major part in safeguarding a diesel engine against breakdown, wear, and mechanical troubles. Badly contaminated oil can cause: (1) bearing failures, (2) stuck piston rings, (3) overheating and power loss, (4) excessive wear, abrasion, and piston seizure, (5) fouled scavenging-air ports, and (6) valve deposits.

Use of a quality lubricant is not enough; the operator cannot assume that his lubrication problem has been completely solved. Mechanical condition, design, and severity of operation of the engine strongly affect the physical and chemical changes taking place in a lubricant in service. The oil deteriorates because it becomes contaminated with: (1) fuel soot and carbon particles, (2) dust and dirt, (3) metallic oxides, (4) metallic particles, (5) water, (6) unburned fuel, (7) organic acids, and, (8) sludge. Reduction in amount and effectiveness of chemical addition agents also occurs. The general result of this contamination is that the oil thickens and increases in viscosity (except, of course, where unburned fuel is the major contaminant).

Viscosity Increase

This general viscosity increase alone is enough to ruin an engine. Laboratory tests recently conducted by a large diesel-engine builder point to elevated temperatures as the principal cause of bearing failures. In modern high-speed diesels, with bearing clearances averaging about 0.0015 in., small localized areas on the bearing surface ride closer to the shaft than the remainder. This leads to uneven temperature and to unequal expansion and contraction of the bearing metal. This constant expansion and contraction gradually develops a check on the bearing surface, which widens and deepens until it reaches the bonding. The oil film develops sufficient hydraulic pressure within itself to drive through this crack and wedge between the bearing metal and the shell, causing larger particles of bearing metal to crack off.

These investigations prove that temperature ranks ahead of pressure as a cause of bearing failure and point to the importance of insuring a copious flood of oil through the bearings to carry away heat. Viscosity regulates the volume of oil which can be pumped through a 0.0015-in.-clearance bearing; in fact, it has been found that about ten quarts per minute of SAE-20 oil can be pumped through such a bearing (total surface 214 sq in.), as compared with only one quart per minute of SAE-40 oil. Laboratory tests on used crankcase oils commonly show viscosity increases from 60 to 120 Saybolt seconds at 210 F, or three SAE grades. Thus it can be seen that oil contaminated in service quickly thickens to a point where its value as a coolant is reduced to the extent that bearing failure may easily follow.

Clogged scavenging-air ports frequently cause failure in high-speed 2-cycle engines. In engines with cylinders lubricated from the crankcase, and trunk pistons, badly contaminated oil will cause such clogging. The operator cannot depend on detergents in the oil to keep air ports clean, because these elements lose their effectiveness under prolonged service.

Every gallon of fuel burned in a diesel cylinder forms over a gallon of water as a combustion byproduct. Low jacket-water temperature causes condensation of this moisture, which prevents proper wetting of cylinder walls with oil and so causes high liner wear. This is particularly apt to be the case in marine engines which are direct cooled and thus have low jacket temperatures.

In some cases, water finds its way past the rings and contaminates the crankcase oil, forming mayonnaise-like emulsions, which accumulate over the oil screens and in the circulatory system. Such emulsions may restrict or block the oil flow to such an extent that bearing failure occurs.

Water also tends to increase the activity of organic acids in oil. These acids are water soluble and tend to become more concentrated when water is present. Thus water in the crankcase may be responsible for corrosion of bearings and other crankcase parts.

Metallic oxides, which accumulate in a lubricant during service, act as powerful catalysts and hasten the oil's deterioration, even though present in small fractions of 1%. Iron oxide may come from a leaky water jacket or cylinder liner, copper and aluminum oxide from the circulatory system or from heated engine parts. Inferior compoundings, made from aluminum soaps, may be the source of aluminum oxide, a powerful abrasive.

Dirt and dust may enter the cylinders through the air-induction system, particularly if filters are not in first-class condition. To understand the effects of dirt and dust entrained in the lubricating oil, visualize a hot piston expanded out against the cylinder wall. With the oil film of microscopic thickness under these conditions, dirt of even microscopic size becomes an abrasive which takes its toll in rapid wear.

Causes of Bearing Failure

In 2-cycle crankcase-breathing engines, bearing failures result, in many cases, from accumulations of dirt introduced with the intake air. In 2-cycle blower-charged engines, it is frequently difficult to filter air fast enough to completely prevent entry of dust. In a 4-cycle engine, the rapidly revolving cranks throw the oil and break it up into a fog or mist, which thoroughly washes air introduced through the crankcase ventilation system. Thus any dirt entering through the ventilation system is easily trapped in the oil.

Refiners face the paradoxical problem of producing, from the same crude, gasoline, kerosene, and fuel oil, which must combine readily with oxygen, and, at the same time, lubricating oil, which

Fig. 1—Effect of contaminated oil on diesel piston and valve

must resist oxidation to a maximum degree. When oxygen combines chemically with the thousands of carbon-hydrogen molecular combinations that form a lubricant, organic acids form. Today's high-quality diesel lubricants contain chemical addition agents which inhibit this oxygen reaction, but these addition agents are subject to oxidation and gradually lose their effectiveness.

Organic acids may become sufficiently concentrated to attack engine parts at elevated temperatures; furthermore, these acids react with the remaining parts of an oil to form sludge. High-quality oils resist this acid reaction to a maximum degree, but presence of organic acids in a lubricant may be likened to one bad apple in a basket. It is the seed of destruction for the rest.

Chemically, sludge may be defined as precipitated, oxidized hydrocarbons. Thus sludge differs from the organic acids because it is insoluble and the acids are soluble. Sludge deposits in quiet parts of the engine, such as valve chambers, crankcase sumps, or timing-gear housings. Sludge settles readily in the cooler, where the lower temperature encourages precipitation. The amount of sludge formed may be taken as a direct measure of the oil's deterioration.

Laboratory reports on used oil, taken from a wide field of diesel service, indicate that thickening occurs in the largest percentage of cases. This indicates that fuel dilution, which has a thinning action, in general, is not a serious problem except where something is seriously wrong with the injection system or where fuel leaks directly into the crankcase.

The discussion of causes and effects of lubricating-oil contamination shows that the rate at which an oil deteriorates depends on engine design and construction, severity of operation, operating temperatures, skill and care of operators, presence of foreign impurities such as dust, kind of service (stationary, portable or marine) and original lubricant quality. Filters, centrifuges, and batch-settling methods of oil purification (see "Clean Diesel Oil Lasts Longer," POWER, p 70–73, Jan '41, p 60–62, Feb '41) are all valuable as a means of lengthening the service life of an oil but they cannot make it last forever. The kind of purification used thus also affects the rate of deterioration.

For all these reasons, it is difficult for any engine builder or oil refiner to arbitrarily select an oil-change period which will be correct, without specific consideration of each engine's operating requirements. Thus laboratory analysis forms the only reliable way to determine the fitness or unfitness of an oil for further service. Tests have been developed to measure the effects of the various kinds of contamination previously discussed and intelligent interpretation of these test results will enable establishment of correct oil-change procedures in any given case.

At this point it is well to emphasize the fact that the oil supplier is best qualified to judge the fitness of his particular oil for further service. From his experience he can study the laboratory results in the light of other important factors, such as nature of the crude from which the oil was refined, degree and kind of refinement, and characteristics of chemical addition agents. However, it is exceedingly valuable for an operator to understand how and why an oil is analyzed and thus to be able to use his own judgment in many cases. In addition, many operators prefer to establish their own laboratory routine and are ably qualified to pass judgment on an oil's condition. The following tests are commonly run and may be considered the ones which tell the most important facts about a used oil.

Viscosity (ASTM D88-38). Viscosity may be defined as resistance to movement of a fluid film. If an oil becomes thickened by fuel soot, carbon, dirt, and sludge, its viscosity will increase. It must not increase to such an extent that it will cause hard starting or seriously impede heat transfer. On the other hand, fuel dilution must not lower viscosity so that lubricating value is reduced.

When measured in the Saybolt viscosimeter, viscosity is expressed in seconds, the amount of time required for 60 cc of oil to flow through an efflux tube, Fig. 3, at a specified temperature. Although the viscosity limits suggested vary with individual cases, it may be generally stated that viscosity should not increase more than 15 sec at 210 F, or decrease more than the same amount. The 210-F temperature permits closer evaluation of oils with varying viscosity indices.

Gravity (ASTM D287-39) Specific gravity of an oil is the ratio of the weight of a given volume of oil at 60 F to the weight of an equal volume of distilled water at the same temperature, both weights being corrected for the buoyancy of air. The API gravity scale relates to specific gravity as follows:

$$\text{Deg API} = \frac{141.5}{\text{Sp Gr}} - 131.5$$

If a lubricating oil becomes loaded with sludge, soot, carbon particles, and dirt,

its specific gravity increases. If it becomes diluted with fuel oil of lower specific gravity its own is lowered. Gravity is an important factor to watch in connection with fuel dilution, because overlapping boiling points of fuel and lubricating-oil fractions make direct measurement of dilution by distillation difficult.

Gravity must be judged carefully in relation to other factors, such as viscosity and petroleum-ether insolubles. If both viscosity and specific gravity decrease, it is a sure sign of fuel dilution, while if both increase, the presence of heavy contaminants is indicated. As was the case with viscosities, individual conditions alter the limiting values set on gravity changes, but a variance of three or four points in API gravity, either way, indicates serious changes in the oil.

Flash Point (ASTM D92-33) The flash point is the temperature at which there will be a sufficient accumulation of vapors above the surface of oil heated in a Cleveland open cup to momentarily ignite as a lighted taper passes over the cup. In a new oil, flash point serves as a rough indication of the degree of removal of light elements and of the oil's vaporization tendencies.

In diesel service, where the oil comes in contact with hot surfaces such as the underside of piston crowns, piston pins, bearings, etc, it is customary for the flash point to increase. Thus oil with a 420-F flash point when put in may show a 15-F increase in a few dozen operating hours, depending on severity of the service and amount of oil in the system.

A marked decrease in flash point, say from 420 F to 320 F, indicates dilution with unburned portions of the fuel which have escaped the piston rings and entered the crankcase. This condition would point to combustion difficulties, such as fouled injection nozzles, poor fuel, or incorrect timing. In some engines, combustion-chamber design is such that dilution is common. If, along with a decrease in viscosity and specific gravity, the oil shows a decrease in flash point, this is positive proof of fuel dilution. It is difficult to assign close limits on permissible flash-point change but it may be generally stated that an increase of more than 20-25 F would be undesirable, and a decrease of more than 60-70 F would indicate serious fuel dilution.

Water (ASTM D95-30) Water is commonly measured in the laboratory by distillation, although a centrifuge may be used. Fig. 4 shows apparatus for this test. Mixing the sample with a volatile solvent facilitates distillation. The water vapor condenses and returns to a graduated trap. The amount of water is reported as percent by volume. Water should not be permitted to exist in crankcase oil in more than small traces. Measurable amounts (1-3%) definitely indicate that the oil should be reconditioned or discarded.

Neutralization Number (ASTM D188-27T) Neutralization number of an oil is defined as the number of milligrams of potassium hydroxide necessary to neutralize one gram of oil. In making this test, 10 grams of used oil are mixed with 90 grams of alcohol containing a color indicator (phenolphthalein). The oil sample and solvent are heated and agitated and the potassium hydroxide is added slowly from a graduated burette. Titration is continued until the indicator changes color. The potassium-hydroxide solution added, of standard strength, represents the total amount of alkaline material necessary to neutralize the mineral and organic constituents of the used oil having acid characteristics.

The importance of neutralization number of a used oil is frequently over-emphasized. It is not an exact criterion of the oil's condition, because the neutral constituents have an important bearing on the preservation of the lubricant's chemical stability, and because the potassium-hydroxide reaction measures only the amount and not the kind of acid present. Some acids become more corrosive to engine parts at elevated temperature than others. Finally, the laboratory test is too far removed from actual operating conditions and the mechanical design of the engine to serve as a positive indicator of the final results of using an oil with an elevated acid value.

Neutralization number must be judged carefully in relation to the amount of petroleum-ether insolubles. If these are high and the neutralization number is also high, the oil should be discarded. If, however, the neutralization number is high and the petroleum-ether insolubles are low, and the other oil characteristics are relatively unchanged, then the oil is probably fit for further service. In general, a neutralization number of 1.75 should be considered a maximum limit on small high-speed diesels and 2.5 can be taken as a limit for large diesels with crankcase capacity in excess of 100 gal. Beyond this latter point the oil should not be used without careful study by both chemist and lubrication engineer.

Precipitation Number (ASTM D91-40) When oil is new it is completely soluble in petroleum ether (ASTM precipitation naphtha). As it changes in service, it becomes contaminated with

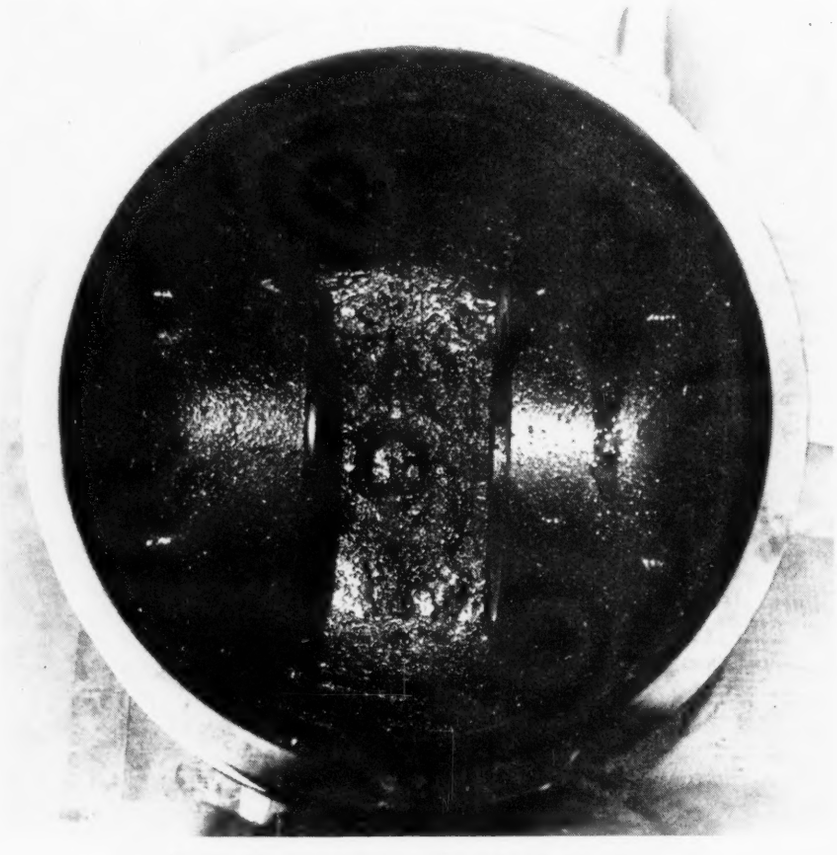


Fig. 2—Note coating on under side of this piston

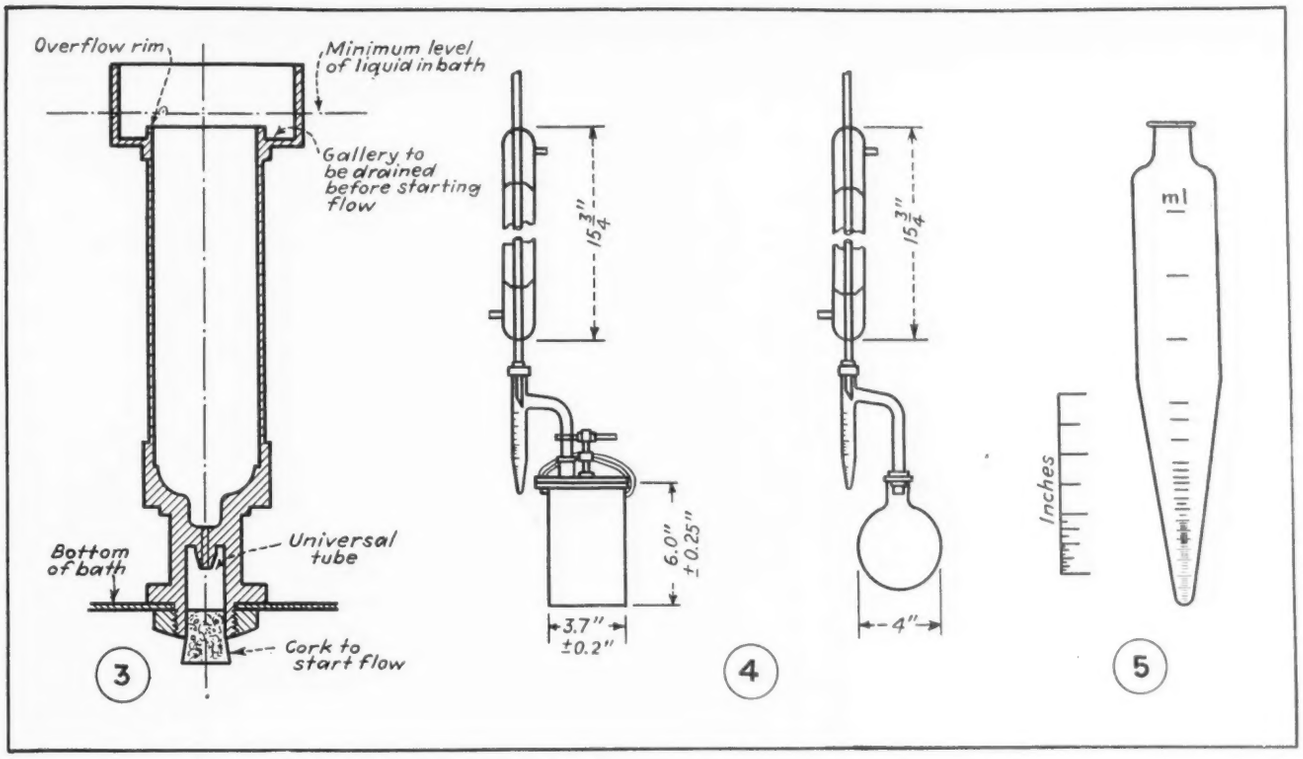


Fig. 3—Standard tube for viscosity measurement. Fig. 4—Apparatus for determining, by distillation, amount of water present. Fig. 5—Cone-shaped centrifuge tube used in measurement of petroleum-ether insolubles

oxidation products and foreign impurities, materials insoluble in petroleum ether. The insolubles include carbon particles, sludge, organic acids, dirt and dust (silica), metallic particles, and metallic oxides. These materials, with one or two exceptions, constitute the most harmful impurities which normally appear in a used diesel oil.

Petroleum ether conforming to the following requirements is used for the test:

Gravity (deg API at 60 F).....70-73
Aniline Point.....58-60
Initial BP (ASTM) not less than 122 F
50% Point (ASTM).....158-176 F
End Point (ASTM) not more than .....266 F

After mixing in the ratio of one part oil to 9 parts diluent, the mixture is centrifuged in a cone-shaped centrifuge tube, Fig. 5. Preferred forms of centrifuge have a swing diameter (tip to tip of whirling tubes) of 15-17 in., and a speed of at least 1500 rpm. The ASTM precipitation number is the number of millilitres of precipitate clearly visible in the apex of the centrifuge tube.

In small diesels (8-10-in. piston dia and 5-10-gal lube-oil capacity) it is felt that the amount of petroleum-ether insolubles should not be allowed to exceed 1%. In larger industrial and marine installations, where oil-system capacity may be anywhere from one to several barrels, a higher percentage, up to 2.5, may be allowed.

The precipitation test is one of the most valuable and reliable means of judging the condition of a used oil. Other solvents and separation methods can be used to break the precipitate into its component parts—oxidized and polymerized hydrocarbons (sludge and organic acids), as distinguished from carbon, soot, dirt and dust, metallic oxides and metallic particles. This more detailed breakdown gives an accurate picture of the actual degree of deterioration of the lubricant. However, for practical purposes, the petroleum-ether insoluble test tells the total amount of entrained impurities in the oil (water, unburned fuel, and certain chemical compounds excepted). When judged in relation to other factors, such as neutralization number, viscosity increase and ash content, it is a valuable guide to an oil's fitness.

Ash Content (ASTM D482-38T) This test measures the amount of mineral and metallic contaminants in used oil. It is made by heating and igniting a 20-gram sample of used oil in a porcelain dish. All combustible materials, such as free oil and carbon, burn away. The remaining ash is weighed and its weight compared to the original sample. The ash can be further broken down into its components by using acids to separate out the silica and lead. Use of ammonium hydroxide separates iron as the hydroxide. Copper is separated as a metal, by electrolysis. The ash content should not be allowed to exceed 0.2%. Some mineral impurities are more dangerous than others, and some flexibility is necessary in considering this factor.

The oil supplier can render a valuable assistance to a diesel operator by periodically obtaining a sample of lubricating oil and submitting a laboratory report on its fitness for further service. The supplier is well qualified to do this because he understands the chemical behavior of his oil and can predict the results of its continued use under a prescribed set of mechanical conditions. The refiner's experience in lubricating other diesels of the same make, operating under similar mechanical demands, is also valuable.

The diesel operator can go a long way toward more reliable and economical operation by realizing that lubricating oil does deteriorate in service and that it must be changed at proper intervals. The chemical laboratory serves as a vital aid in determining this correct oil-change period and is more reliable than the haphazard, arbitrarily scheduled change period often mentioned in instruction books. Whether he uses an outside laboratory or his own, the tests and limits suggested here will serve as valuable guides to the operator in understanding the exact condition of the lubricating oil in his engines.

Here's How to Defend the Industrial Plant

As a first step in planning the "inside" defense of American industry, the Office of Civilian Defense, Washington, D. C., has issued a booklet, "Protection of Industrial Plants and Public Buildings", here presented in condensed form. While this document stresses air-raid precautions, the plant organization outlined is good insurance against all explosions, fires and other physical disasters, regardless of origin

▶ THE PROTECTIVE ORGANIZATION in each industrial plant, business establishment, or public building should consist of a Plant Defense Coordinator and four heads of divisions: Fire, Police, Medical, and Maintenance.

The Plant Defense Coordinator is responsible for developing a communication system within the plant to permit the immediate transmission of messages between the Coordinator and squads organized under the various divisions, and between squads. The report center under the Coordinator should have a system of reports from each squad and from each key position so that he will know when his plant is "manned and ready."

★

Readers planning to install a plant-defense system should get the complete booklet from the Office of Civilian Defense, together with any other literature applicable to industrial plants and buildings. *Editor*

★

All transportation equipment should be allotted by and under the control of the headquarters of the Plant Defense Coordinator. He should be a clear-thinking individual capable of taking charge of action in an emergency. He has full responsibility for preparing plans, organizing and equipping squads, and training personnel. During an emergency he has control of the dispatch of all squads.

Squads should be organized within each division. The training of personnel should provide first for the training of individuals, then of squads. Thereafter, the entire organization should be trained collectively to insure the fullest degree of teamwork, cooperation, and usefulness.

The Plant Fire Chief should be the head of the fire-fighting forces. He will be responsible for the fire-fighting brigade and for the equipment, both stationary and portable, permanent and temporary. An inspection and survey should be made immediately and all precautions taken, such as the removal of old equipment and rubbish from roof spaces. Access to the roof should be provided. The adequacy and availability of water supply, both main and auxiliary, should be studied. All men assigned to the fire brigade should be taught the latest methods of fighting fires and dealing with incendiary bombs.

Fire-watcher squads should be organized, equipped, and trained. Their duties will be to watch for, locate, and handle incendiary bombs so as to prevent a small flame from becoming a conflagration. Normally, fire-watcher squads will handle incendiaries, but they should be prepared to call for assistance.

Rescue squads of specialists, such as engineers, carpenters, bricklayers, welders, shorers and electricians, should be organized, equipped, and trained to rescue people from damaged buildings. Their duties may be extended to include emergency handling of utility services.

A competent fire organization consists of:

1. A main observation post, with such additional observation posts as may be necessary.

2. Protected elevated fire-watcher posts, with necessary men, equipment, and independent water supply.

3. Fire posts conveniently situated, but dispersed and decentralized.

4. Adequate main and auxiliary water-supply systems.

5. Fire squads organized and ready to deal with incendiary and high-explosive bombs and fires.

6. A direct communication system between fire-watcher posts, fire squads, and the headquarters of the Fire Chief.

The Plant Police Chief should be in charge of all police activities, the work

TYPICAL EQUIPMENT

Fire-Watcher Station (4 Men)

1 pair of leather or asbestos gauntlets for each watcher
1 pair of dark safety-glass goggles for each watcher
1 steel helmet for each watcher
1 all-purpose gas mask for each watcher
4 water buckets
1 sand bucket with 3 or 4 in. layer of sand in bottom for use in removal of incendiary bombs
1 portable water pump
1 long-handled, flat, square-nosed shovel
1 fire axe
2 bags, each filled with about 10 pounds of sand
2 electric lanterns
2 one-pound sealed packages of copper sulphate to be dissolved in water (1 pound of copper sulphate per bucket) for use on phosphorous
3 blankets and large safety pins
1 crowbar
100 feet of ½-in. line
3 corrugated iron sheets

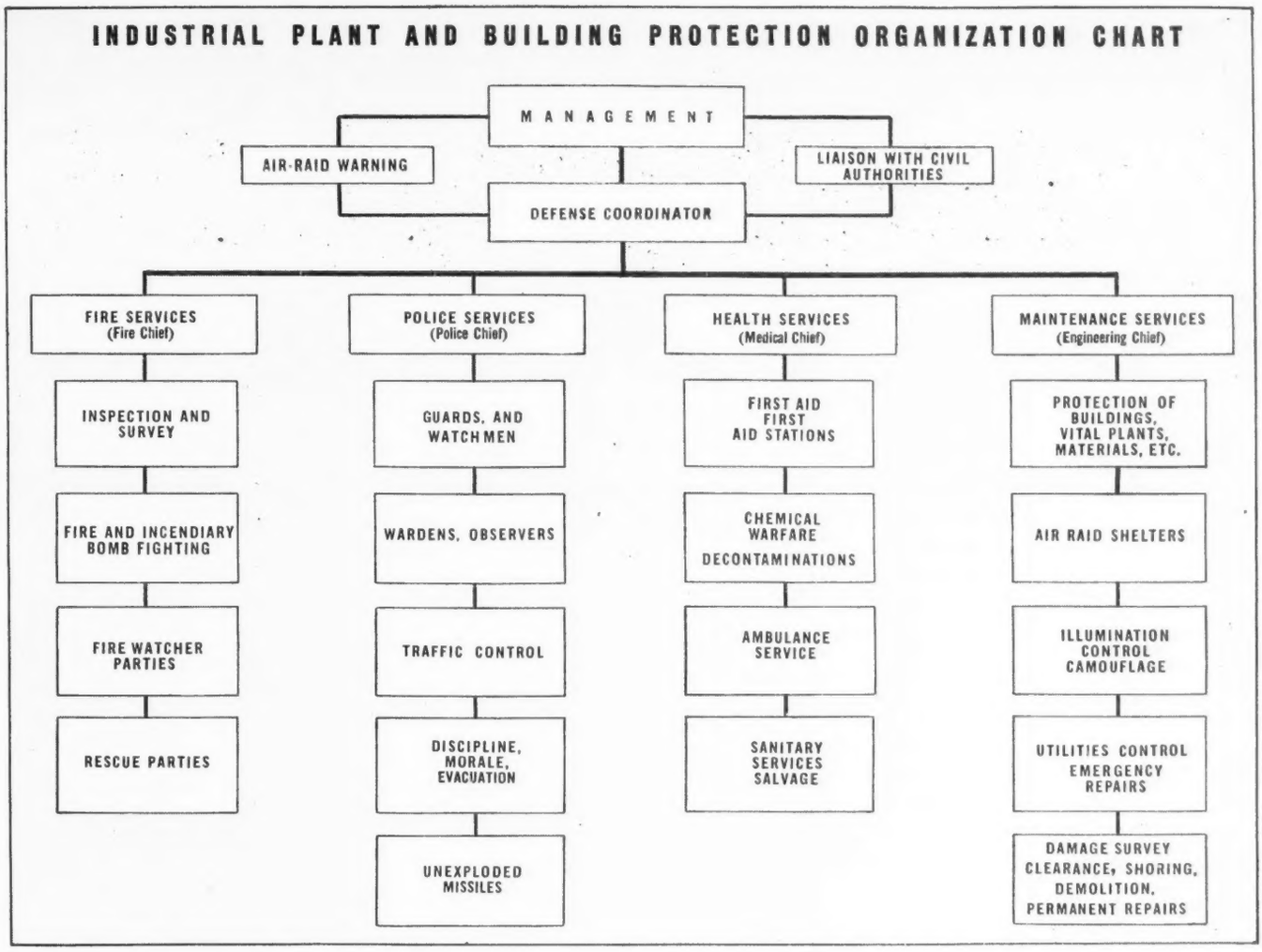
Duties of Squad

Member No. 1 Direct and handle nozzle
Member No. 2 Operate portable pump
Member No. 3 Refill water bucket
Member No. 4 Assist and act as runner

Utility Control Squad (4 or 5 Men)

1 helmet each
1 all-purpose gas mask each
3 or 4 electric lanterns with spare bulb and battery for each
1 truck with driver
1 bound map of utility service showing layout of distribution systems, location of valves, switches, etc
Proper tools, supplies and equipment for efficient execution of assigned duties

(Note:—*All of the above should be kept available on the truck*)



of air-raid wardens and aircraft observers, training in gas defense and the wearing of protective devices. He should have general responsibility for maintenance of discipline and for development of morale.

The Police Chief should supervise all guards and watchmen, should be responsible for all persons entering the plant area, and should be charged with safeguarding the plant and its material from subversive activities as well as from theft. He should control all traffic and maintain a clear route to permit the necessary automobiles, rescue trucks, etc. to reach the scene of an incident.

Under the Plant Police Chief, there should be a Senior Air Raid Warden in charge of all wardens and observers.

The observers should be placed on the top of a substantially constructed building in order to command as extensive a view as possible of the surrounding buildings and areas. They will report the approach of planes, bombs dropping, fires, or anything unusual of which the Senior Warden should be informed.

The wardens will be prepared to handle the evacuation of employees from the plants to air-raid shelters. The wardens will make certain that all lights are extinguished during a blackout except those permitted to remain lighted for safety or other reasons.

The Plant Medical Services should be under the plant physician or a practicing physician. In addition to his regular training, the Plant Medical Chief should be qualified to handle poison-gas cases.

The maintenance services should be under the Engineering Chief, who should be a competent all-around engineer, qualified to act in a cool manner in all emergencies. He should have as his assistants the technicians who deal with plant utilities—electricity, steam, gas, water. Skilled workers, such as plumbers, pipe-fitters, machinists, welders, etc., should be detailed to key positions ready to do whatever is necessary.

The first step should be to survey the plant and make the necessary preparations for the protection of all buildings.

Air-raid shelters should be prepared for protection from both gas and bombs. Consideration should be given to the safety afforded by these shelters, to entrances and exits, lighting, heating, and ventilation.

The control of illumination (blackout) should be studied. Means should be developed to control quickly, to any desired degree, all artificial light so that no light will be visible externally during a blackout.

Key men should be stationed in pairs at the various utility controls, such as telephone switchboards, gas, steam, and water controls and boilers. These men must remain at their post during an air raid to handle any emergency.

Because the key men must not be removed from their posts, organized repair crews must be ready to handle any emergency in any particular circuit.

POWER asked Rear Admiral C H Woodward of the Office of Civilian Defense whether these precautions have a broader objective than air-raid protection. He replied: "The duties of a civilian defense organization in a factory or institution are not limited to air-raid protection, but can properly act to protect a plant from all kinds of accidents, whether natural or otherwise. . . . "We would also appreciate your stressing the fact that the responsibility for the safe-guarding of the personnel and of the plant rests squarely on the management—that the initiative which the management shows in organizing the individual plants will be a criterion of its foresightedness."

More Life From Gearmotors

H W Bennett, General Electric Co motor engineer, explains the importance of adequate gear capacity, proper foundations and supports, and accurate alignment in trouble-free performance

► Between 75 and 80% of all electric motors are connected to their loads by some kind of speed-reduction transmission. This is because high-speed motors have better overall characteristics than low-speed motors. Because a motor is a constant-torque device, it is necessarily true that as its output speed is decreased, its physical dimensions must be increased to obtain constant-horsepower rating. Therefore, the usual practice in motor applications is to select a high-speed motor with its desirable features of compactness, low weight, good operating characteristics and low cost, and connect it to the slow-speed shaft of a driven machine by means of a flat-belt, V-belt, chain, gear reducer, or gearmotor drive.

Rating Limit

A gearmotor is one of the most economical types of mechanical power-transmission units to use up to approximately 75 or 100 hp where the speed reduction is greater than 3 to 1, or, with speed reductions of less than 3 to 1 if compactness and appearance are also desirable. A gearmotor may generally be used on any application which can be motor driven. The gearmotor, however, like other power equipment, must be selected with care if a reasonable trouble-free life is expected from the unit.

The two most important factors in

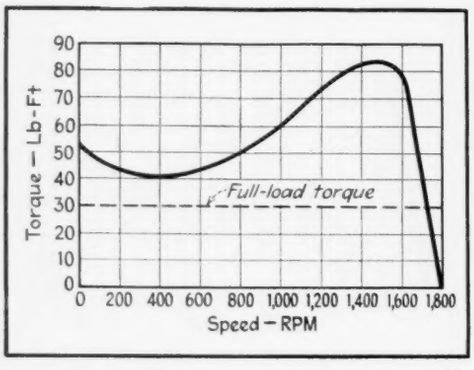


Fig. 1—Motor torque varies over a wide range with speed changes

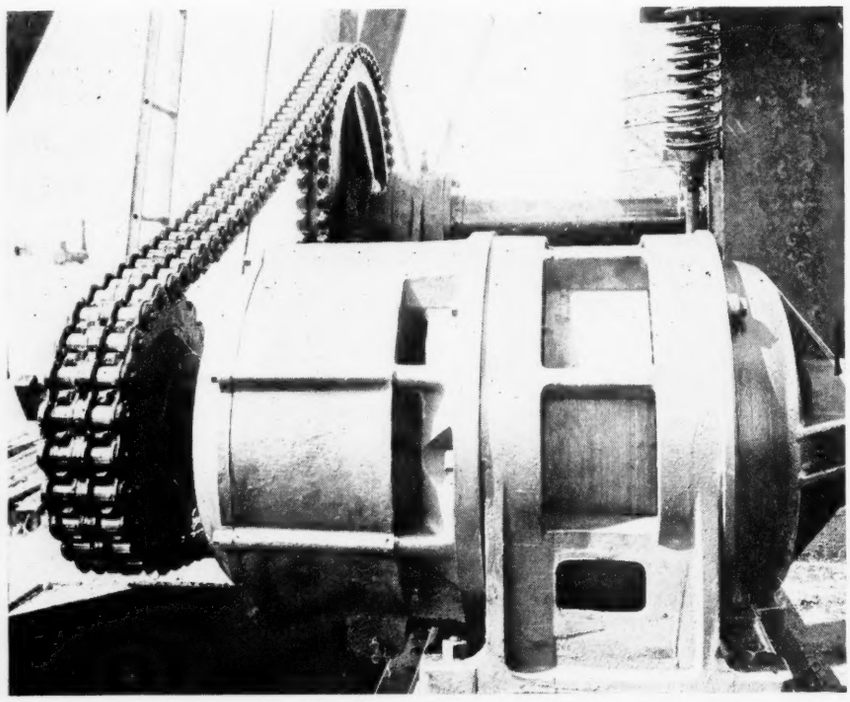


Fig. 2—A 30-hp single-reduction gearmotor drives long-stroke pump in oil-well service

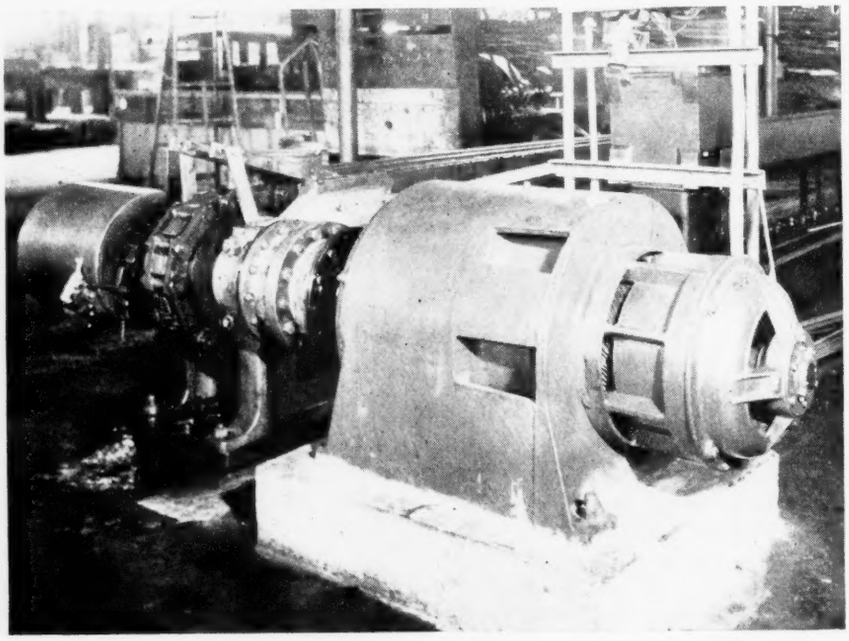


Fig. 3—A 30-hp double-reduction 17-rpm-output-speed gearmotor drives a draw bench

motor applications are ample torque and sufficient thermal capacity. If a load requires more than normal full-load torque from a motor, the motor will deliver the torque as long as it does not exceed its maximum capacity, usually 200 to 300% of full-load rating. This overload, if it is sustained for any length of time, causes the motor temperature to rise. When the motor load is reduced its temperature will drop and no harm will be done as long as the insulation temperature limit is not exceeded.

A gear, however, is entirely different from a motor. Overloading a gear beyond its normal rating results in abnormal stresses in the teeth that cause excessive wear. No amount of load reduction will replace the material worn from the teeth. Therefore, the maximum load torque must be known before a gear can be properly selected.

Another important factor in gear selection, besides maximum-load torque, is the rapidity with which torque peaks occur. When a motor drives a pulsating-torque load, it will run at its rated full-load speed if the load torque equals motor full-load torque. When the machine load increases the motor must slow down to deliver more torque; conversely its speed will increase when the load decreases. This increase and decrease in motor speed changes the kinetic energy, or rotor flywheel effect. A gear, therefore, must be capable of transmitting two types of torque either singly or in combination: normal torque developed electrically and magnetically by the rotor, and mechanical torque due to kinetic energy released when the rotor slows down.

Fig. 1 indicates the variations in torques which a motor can deliver over its output-speed range. Starting at maximum speed, any torque increase is accompanied by a reduction in motor speed, until maximum torque is reached, which in this case is nearly 300% of normal full-load value.

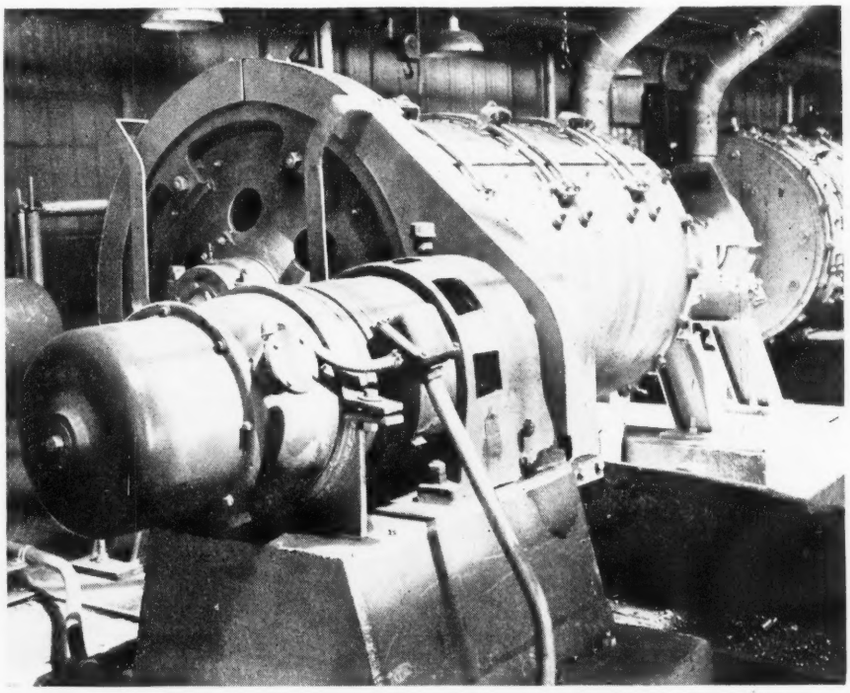


Fig. 4—Fan-cooled gearmotor with motor-mounted brake geared to tumbling barrel

Fig. 5—Splash-proof gearmotor rated 15 hp 45 rpm drives a bucket-type elevator

Flywheel Effect

Torque developed by the flywheel effect of the rotor is determined by the kinetic energy available in the rotating mass and is inversely proportional to the rate at which the rotor speed is changed. Therefore, where gears are applied on loads which have rapidly pulsating torques or on loads where sudden stops may be made, they must be selected to take care of torque due to flywheel effect as well as normal-load torque of the motor.

In one extreme application, the driven machine jammed, causing its 1.5-hp motor to deliver a torque equivalent to the full-load torque of 150-hp motor, or 100 times the normal full-load torque of the 1.5-hp motor. Applications that have torque peaks occurring once an hour do not require a gear with as much capacity as would be needed on loads where peaks occur many times a minute, such as reciprocating pumps. Therefore, as the frequency of the peaks increases, the gear rating must approach the maximum peak more closely.

Starting Torque

Starting torque of general-purpose motors usually used with gears will be between 150 and 200% of the full-load value. Since these torques impose a momentary overload on the gears, the gears' rated capacity must be raised as the frequency of starts increases.

It is estimated that about 50% of all gearmotor applications run 8 hr per day. For this reason the gear portion of a gearmotor is normally designed to carry motor rated horsepower with infrequent starting and a fairly even torque for that period. If the service re-

quires a gearmotor to run longer than 8 hr per day, and the same gear life is desired as expected on 8-hr-per-day operation, a gear with more capacity should be used. This reduces the working stresses, causes less wear and normally gives the gear a longer life.

Some applications run 24 hr per day for only three or four months out of the year. Since the hours of operation are the same as a gear running 8 hr per day for 12 months, the same gear may be used with comparable length of life in both applications, other conditions being equal.

Rigid Foundations

A gearmotor should have a solid foundation that will not weave. Most users recognize that a motor requires a strong mounting support. If we compare a 5-hp, 1750-rpm motor which has a full-load torque of 15 lb-ft with a 5-hp gearmotor with an output speed of 17.5 rpm and a full-load torque of 1500 lb-ft, there certainly can be no question that the gearmotor requires a much stronger foundation. If the foundation is so light that it permits weaving, abnormal stresses will be set up in the gear housing, shaft, and bearings, which will cause failure eventually of one or more of these parts.

They will fail, too, if the driven apparatus is inadequately supported, or if both the driven and driving machines are rigidly supported but have their shafts badly out of line. A gearmotor necessarily has short bearing spacing on the output shaft. If a long driven shaft is eccentric with the gear shaft, it will impose tremendous loads on the gear shaft and bearings.

A gearmotor, with the bearings on its output shaft spaced 10 in. apart, connected to a 10-ft agitator shaft, has a force of 100 lb imposed on the outer end. This 100 lb on the driven shaft will produce a radial load on the gear bearings of approximately 1200 lb. On the other hand, if the agitator shaft is supported by its own bearings and is not aligned correctly with the gear shaft, there will be a tendency for the "tail to wag the dog," and failure of either the gear shaft, bearings, or housing may occur.

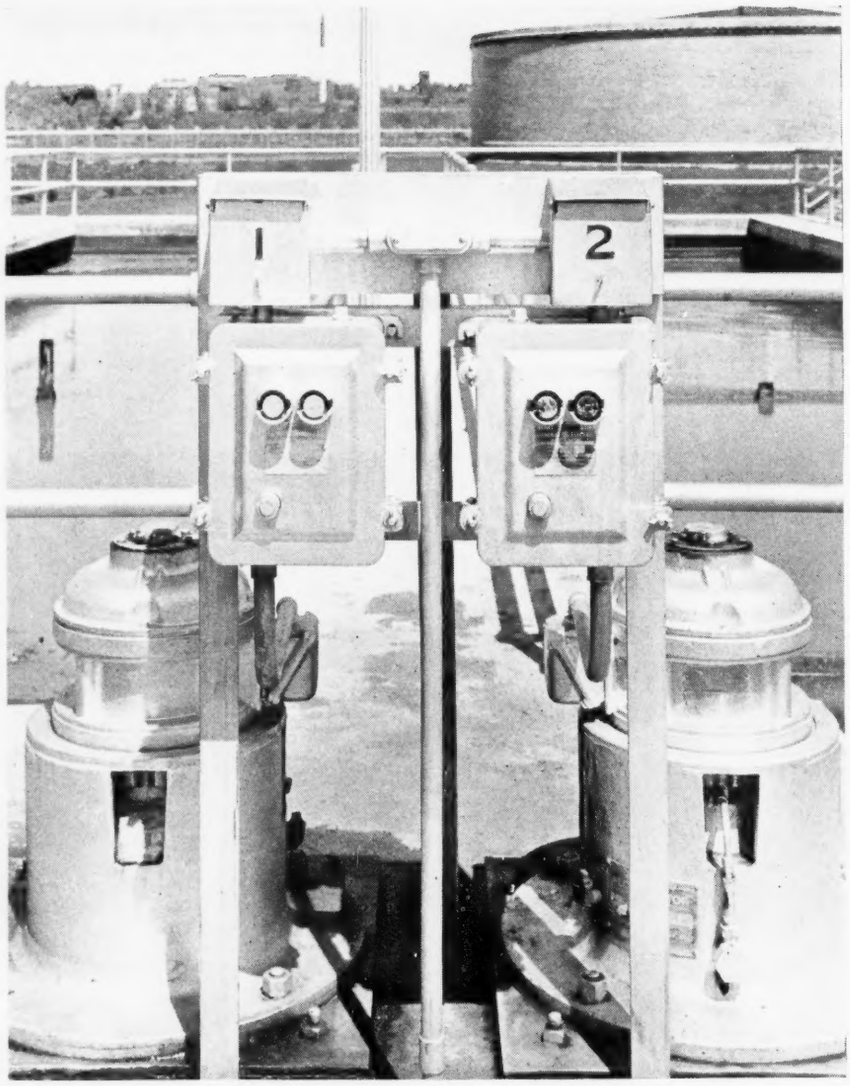


Fig. 6—Two totally inclosed vertical gearmotors, rated 3 hp at an output speed of 8.5 rpm, installed outside on a sewage disposal-plant flocculator

A man who gives his car proper attention and maintenance may get twice as long life from it as someone who never gives his car any service. The same analysis holds true with gearmotor users. A gear that is properly selected, lined up, and serviced will last considerably longer than one that does not receive careful attention.

Some applications unfortunately require gearmotors to be located in almost inaccessible places, or connected to drives where accurate shaft alignment is impractical. Under these conditions gearmotors with gears as much oversize as economical to use should be selected and overhauled less frequently.

If the factors affecting gearmotor life are taken into consideration when selecting them the purchaser should expect years of trouble-free economical operation with little attention needed except infrequent lubrication maintenance.

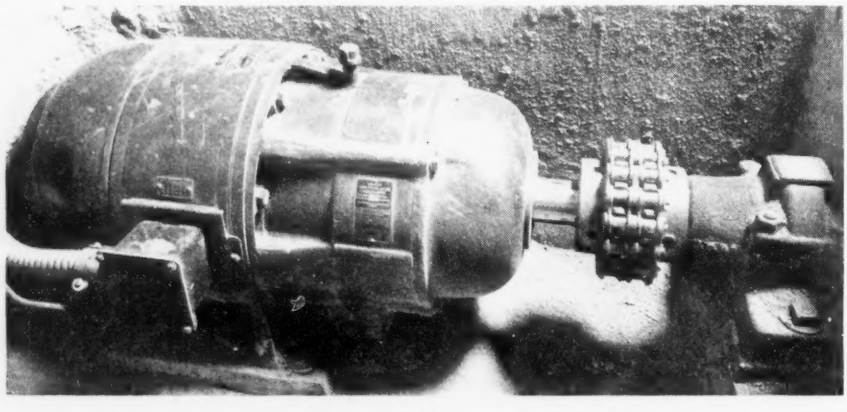
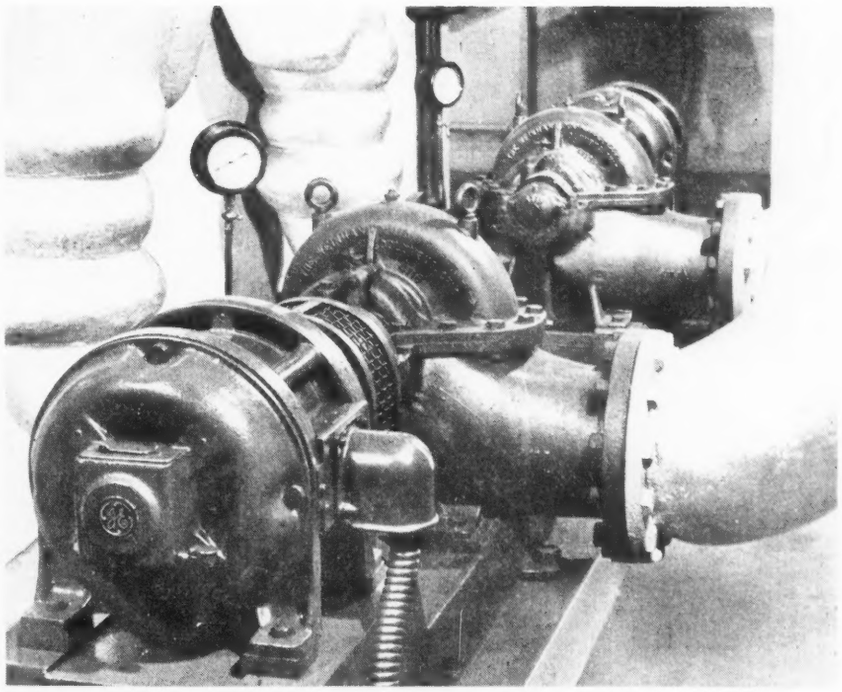


Fig. 7—Totally inclosed, fan-cooled, 10-hp gearmotor operating at 124-rpm output speed driving a screw conveyor in a flour mill

How to Figure Tricky Pump Heads

Frank Kristal compares heads in feet and pounds per square inch developed by centrifugal pumps handling different liquids



A centrifugal pump will develop the same head in feet of liquid pumped irrespective of the specific gravity of the liquid

► PURCHASERS OF PUMPS handling brine or other liquids having a specific gravity different from that of water are sometimes confused when figuring total heads to give to the pump manufacturer. Since incorrect heads cause pump and motor troubles, it is important that these be figured properly.

Head on pumps handling water is usually measured in feet. In case the head is given in pounds per square inch, it is a simple matter to change it to feet by multiplying by 2.31. For example, if the head is given as 56 lb, then the head in feet is 56 x 2.31 = 129.36, say 130 ft. Pump casing and impeller designs are usually made on the basis of data obtained when the pump is handling water. Therefore, pump engineers and manufacturers ordinarily convert all pump data to a water basis, so that they have the capacity in gallons per minute and the head in feet. Pump selection tables and curves are normally arranged that way. For this reason, pump purchasers should know how to transform this information to a water basis when necessary for pump selection.

Head in Feet

The head in feet to which a column of liquid can be raised by a centrifugal pump is a function of its impeller diameter and speed. Specific gravity of the liquid does not affect this head. In other words, a pump that will develop a head of 100 ft when handling water will also raise brine 100 ft. However, the horsepower required to drive the pump when handling brine will be greater in proportion to the ratio of the specific gravities of brine and water. Thus, if the pump requires 12 hp to drive it when handling water, when pumping 1.25-specific-gravity brine it would require 1.25 x 12 = 15 hp. In the same way, when handling a light oil having a specific gravity of, say, 0.8, the pump that develops a head of 100 ft when handling water will also produce a head of 100 ft of oil when pumping oil. Power to drive the pump when handling oil will be only 0.8 that needed when pumping water; that is, if the pump takes 12 hp to drive it when pumping water, it will take only 12 x 0.8 = 9.6 hp when handling oil of 0.8 specific gravity. Where the head in feet that a pump must operate against is known, power to drive it may be found by the formula:

$$Hp = \frac{Gpm \times H \times S}{3960 \times Efficiency}$$

where H equals the total dynamic head in feet and S is the specific gravity of the liquid pumped. For an example, find the power required to drive a 200-gpm, 125-ft head pump with an efficiency of 0.70, when handling 0.8 specific gravity oil.

$$Hp = \frac{200 \times 125 \times 0.8}{3960 \times 0.70} = 7.2$$

If the pump were handling water, the specific gravity would be 1 and the driving power would increase to 9 horsepower. When pumping 1.25 specific gravity brine the pump would require 11.25 hp to drive it.

Very little trouble is usually encountered when head is known in feet. It is when head is expressed in pounds that pump users become confused, but the change from one to the other is quite simple. For example, if a pump is required to handle 1.25-specific-gravity brine against a total dynamic head of 40-lb-per-sq-in. pressure, what is the equivalent of this head in feet?

Pressure in Feet

To express this pressure in feet of water as the pump engineer would do, multiply the pressure in pounds by 2.31 and divide by the specific gravity of the liquid. Thus, 40-lb pressure of brine is equal to 40 x 2.31 ÷ 1.25 = 73.9 ft. This is the total dynamic head that the pump must be good for. In other words, when a pump operates against a total dynamic head of 73.9 ft of brine, it is developing an equivalent pressure of 40 lb. Similarly, a pump handling light oil having a specific gravity of 0.8, and having to operate against a total dynamic head equivalent to 40 lb, would have to be designed for a head of 40 x 2.31 ÷ 0.8 = 115 ft. To develop these heads the impeller diameters will have to be different for each liquid, the lightest fluid requiring the largest diameter.

Simplicity Marks Design of Air-Blast Circuit Breakers

Construction and operational features of three types of circuit breakers, each using compressed air to open or close the breaker contacts and blast out the arcs described in AIEE paper

► DURING RECENT YEARS medium- and high-voltage circuit-breaker design has been practically revolutionized. One of the most important of the new developments has been the adoption of compressed air to open and close the breaker and extinguish the resulting arc. This has eliminated use of large quantities of oil. Several of these designs have been described in the July, 1940 and the January and August, 1941, issues of POWER. This article, based on a paper by H W Haberl, Montreal Light, Heat and Power Co, and Otto Jensen, I-T-E Circuit Breaker Co, and presented at the annual convention of the American Institute of Electrical Engineers, describes three other designs.

Outdoor Breaker

Fig. 1 shows a 138-kv outdoor breaker built by the English Electric Co of Canada. This breaker consists of a tank in which compressed air is stored at 100 lb, three interrupting elements and a 3-pole isolating switch. The blast valve V, Fig. 2, built into the side of the tank has a large air outlet. An 8-in. orifice O forms the outlet for this valve, normally closed by a large thick rubber diaphragm D. Air is admitted through bypass B below the diaphragm to hold the valve closed as long as opening value O_1 remains closed. Valve V_1 for controlling air to the isolating-switch operating cylinder C, is similar to V and is actuated in the same manner.

For 138-kv service the interrupter has three identical arc-interrupting elements in series. Each element has two stationary contacts bridged by a movable contact, thus making two breaks in series per element. Each movable contact connects to a piston P working in a bronze cylinder insulated from adjacent cylinders. Fig. 2 shows the breaker closed.

Below diaphragm D the air volume can be exhausted to atmospheric pressure by 2 or 3 orifices O_1. These orifices are closed by diaphragms held against them by a spring in the opening coil. When the coil is energized, either by the opening switch on the switchboard or by the overload relay, the diaphragms are pulled away from the orifices. This causes the pressure below diaphragm D to drop to nearly atmospheric and the air pressure above D quickly forces it down, Fig. 3.

Compressed air now rushes up the porcelain blast tube into the interrupting chamber and forces interrupting pistons P to open the contacts. As the contacts open, arcs form, but are blasted out by compressed air flowing between the contacts at high velocity, as illustrated in Fig. 3.

While pressure builds up quickly in the interrupting chamber to open the contacts, it also increases in the right-hand end of the isolating switch cylinder through pipe P_1. Because of the small size of this pipe, pressure increases much slower in cylinder C than in the interrupting chamber. As the isolating pistons start moving to the left they compress the air in the left-hand

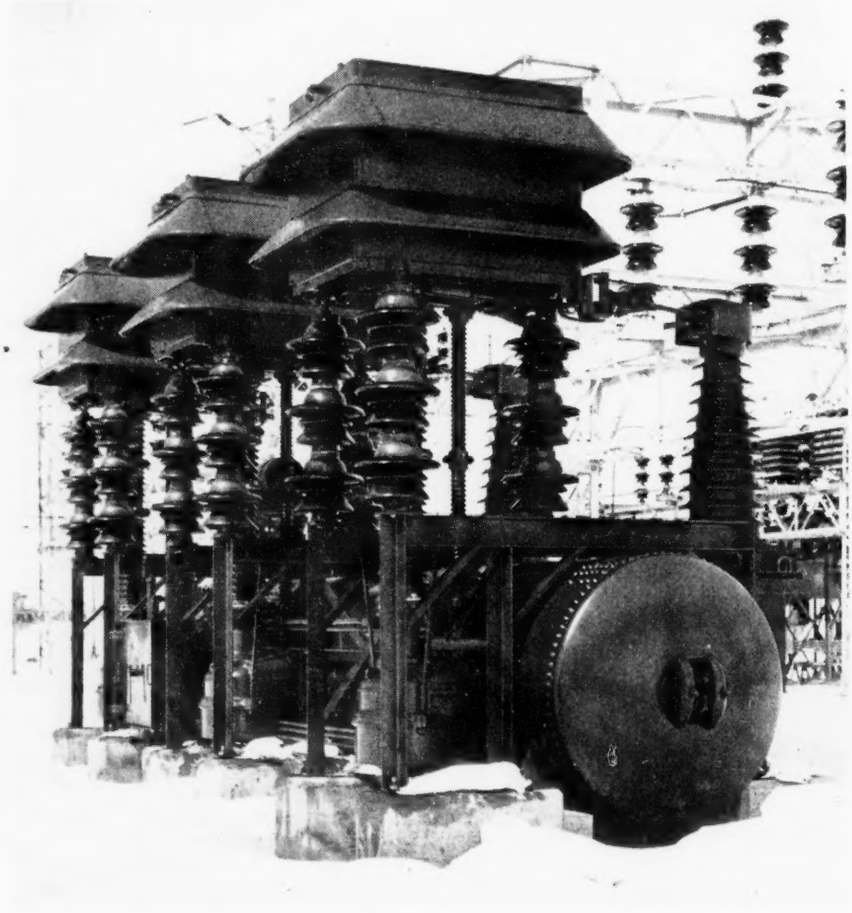


Fig. 1—A 3-pole 138-kv air-blast breaker with one compressed-air tank and three blast valves, one for each pole, installed outdoors

end of the cylinder and down into the closing-valve insulator.

Air pressure also builds up on the left-hand side of the trip-free-valve piston through pipe P_2. When pressure behind this piston becomes sufficient to compress the valve spring, the valve moves to the right and opens a port to atmosphere, Fig. 4. This causes the pressure on the left-hand side of the isolating-switch piston to drop suddenly and the pressure on the right-hand side of the piston quickly opens the isolating switch, Figs. 4 and 5. The action of the trip-free valve insures that once the isolating switch pulls free of its contacts it will go to full-open position.

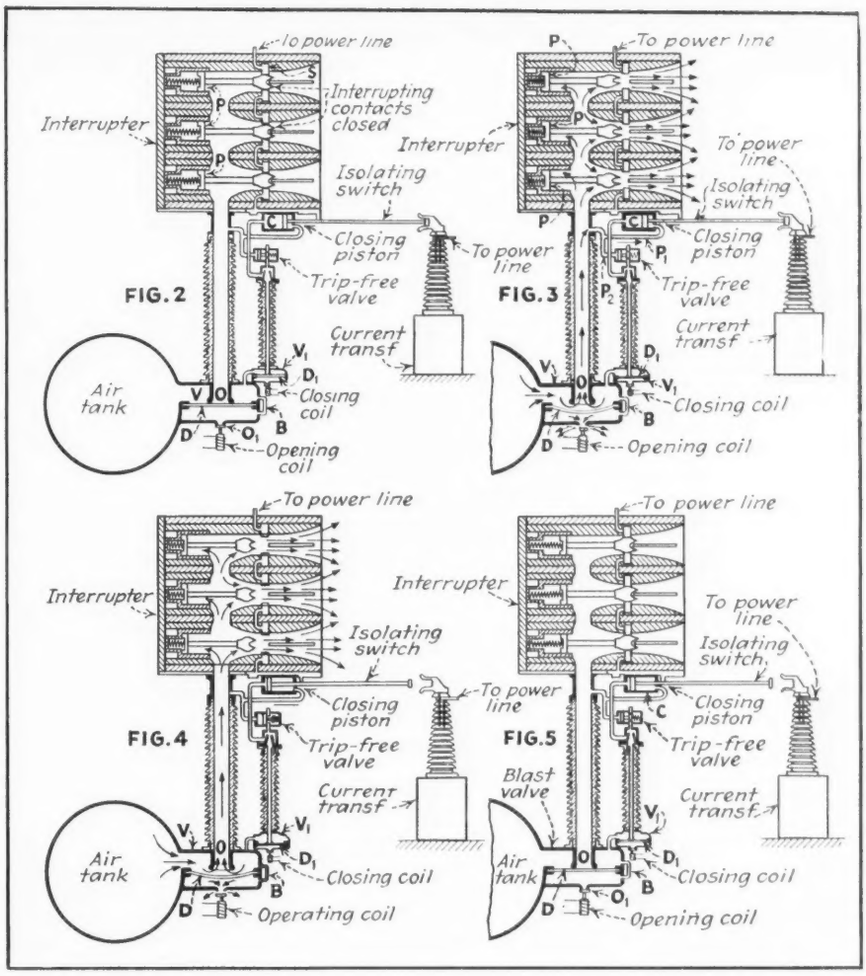
When the isolating switch is almost fully open, an auxiliary switch opens the trip-coil circuit, and the spring in the trip coil closes the trip valves. Pressure then builds up under diaphragm D to close it against the orifice and stop the air blast to the interrupting chamber. The arc-interrupting contacts now close, Fig. 5, leaving the breaker ready to reestablish the circuit by closing the isolating switch, Fig. 2.

Rate of Operation

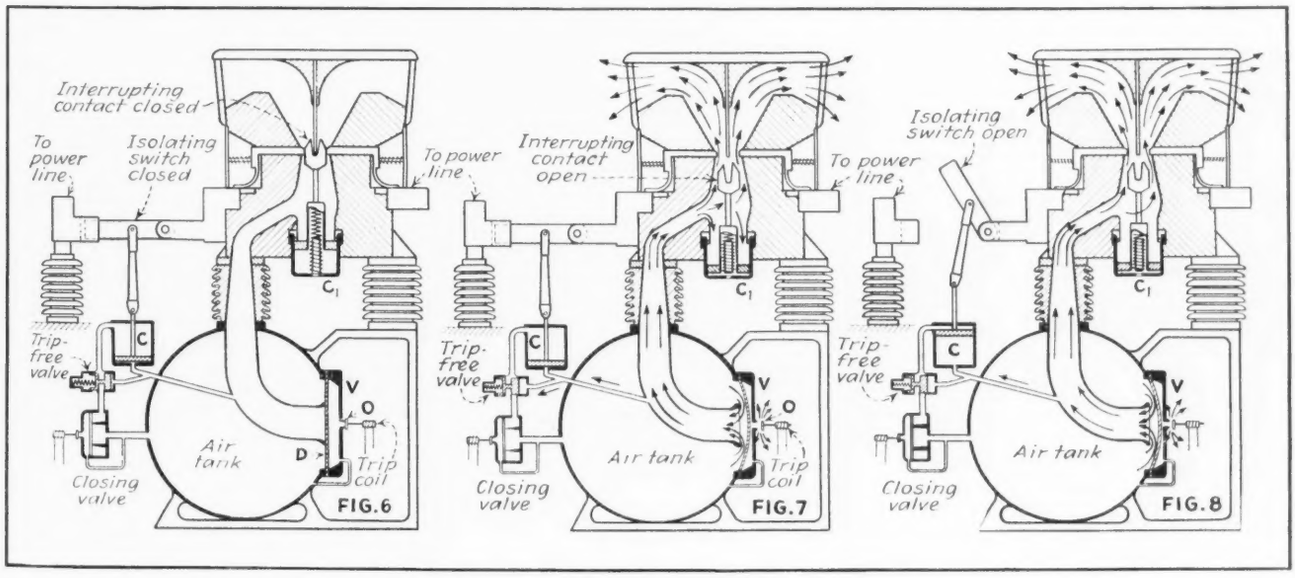
Pressure in the interrupting chamber builds up so rapidly that the interrupting contacts open and the arc is extinguished in about 3 cycles, on a 60-cycle basis, from the instant the trip-coil circuit is closed. In general the breaker can be opened and closed several times in quick succession before the tank air pressure falls below a safe-operating limit.

When the closing coil is energized it opens the valve below diaphragm D_1. Pressure above the diaphragm forces it downward and compressed air flows up inside of the insulator and into the left-hand end of the isolating-switch cylinder C to close the switch. When the switch is nearly fully closed an auxiliary switch opens the closing-coil circuit and the closing valve is released against its seat, when pressure again builds up below diaphragm D_1 to close it to its seat.

The low-voltage breakers operate on



Figs. 2 to 5 show how the breaker, Fig. 1, functions when opening a circuit. It has three interrupting elements in series per phase, each individually air operated



Figs. 6 to 8—This 37-kv breaker has only one blast valve for all three phases and only one interrupter element per phase

the same principle as high-voltage units, but are of a different construction. Fig. 6 shows a 37-kv breaker, built by the I-T-E Circuit Breaker Co in the closed position. The interrupter has only one moving contact per pole, rigidly connected to a steel piston rod and piston, moving in a vertical cylinder C_1.

One blast valve V, the same general design as on the higher-voltage breaker, and air tank serves the three poles. The blast-valve outlet divides three ways inside the tank and the three tubes pass through the tank to their respective poles. All three poles of the isolating switch are operated by one air cylinder.

Circuit-Breaker Operation

To open the breaker the trip coil is energized, uncovering exhaust port O from valve V, which takes the position shown in Fig. 7. Compressed air then rushes into the interrupting chamber. Pressure in this chamber forces the piston down to open the interrupting contacts as shown. When the interrupting contacts open an arc is drawn and quickly extinguished by the air blast.

While the circuit is being opened in the interrupting chamber, air pressure is slowly building up under the isolating-switch piston in cylinder C and behind the trip-free valve. By the time the arc is interrupted, pressure behind the trip-free-valve piston is high enough to move the valve to the left and connect the top side of the isolating-switch cylinder to atmosphere. This permits the piston to move the isolating switch to full open, Fig. 8.

Before the isolating switch reaches full open, it opens an auxiliary switch in the trip-coil circuit and its valve closes. As the interrupting contacts open, the air is quickly exhausted from their chamber and the springs close these contacts. Operations for closing the isolating switch are just the same as for the 138-kv breaker, Fig. 5.

Indoor Breaker

Fig. 9 shows a breaker designed for 4- to 15-kv indoor service, 2000 amp, built by Eastern Power Devices, Ltd of Canada. In this type the blast valve and the interrupting elements are the same as on the previously described breakers, but the movable arcing contacts connect by a rod to the center of diaphragm D. The trip valve is also opened and closed by a diaphragm, D_1.

To open the breaker the trip coil is energized, opening its valve O_1 and releasing air from below diaphragm D_1. Air pressure above diaphragm D_1 forces orifice valve O open to release the pressure below diaphragm D. Pressure in the upper part of the tank deflects this diaphragm, Fig. 10. To insure that the contacts do not part before the blast arrives to interrupt the arc, a small amount of lost motion between diaphragm D and the operating rod is provided. This permits the diaphragm to open the valve partly before the contacts start to move. Action of the lost motion insures a quick contact break and allows air pressure to build up at the contacts before they part. After the arc is drawn and instantly extinguished by the air blast, the isolating switch is opened in the same way as on the other two breakers.

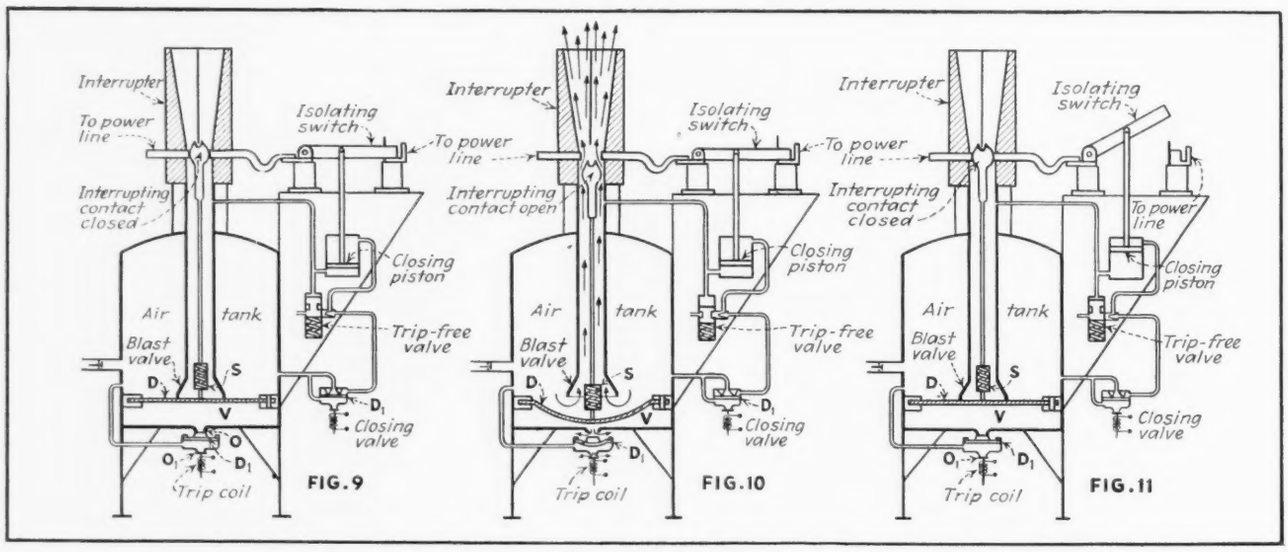
The air blast by the interrupting contacts is stopped and these contacts close first by the isolating switch which opens an auxiliary switch in the trip-coil circuit, permitting the trip valve to close. Pressure then builds up under diaphragm D_1 and its valve closes; then pressure is restored under diaphragm D. This then moves up to close the arcing contacts and the lower end of the blast tube, Fig. 11. A spring S in the operating rod reduces shock on the operating parts during the breaker opening.

In the diagrams the blast-valve outlet is shown as a single tube, but it divides into three, each going to a vertical blast tube. Floor space required for the breaker is reduced by placing the air tank vertically, so that a 2000-amp breaker has a width of only 30 in. This design is well adapted to various indoor station layouts. This design may also be turned upside down and adapted to cells for old-style oil circuit breakers with live parts at the bottom.

69-Kv Air-Blast Breaker

A 69-kv air-blast breaker built by the English Electric Co of Canada also has one blast valve the same as previously described, for the three poles. Passing horizontally out of the tank, the blast tube connects to a horizontal header serving the tubes of three vertical interrupting elements. Interrupting contacts are opened by pistons, as in Figs. 2 and 6, but the three piston rods are mechanically tied together through short links and a common shaft. On the isolating switch the three blades are operated by a common cylinder instead of a cylinder on each blade.

Service records of breakers of this design date from 1934 when a 138-kv breaker was installed. Since then breakers of several other voltages have been placed in service and the record is now equivalent to over 20 breaker-years of service. Over 15 breaker interruptions of short circuits have been reported without any failures.



Figs. 9 to 11—In this 12-kv air-blast breaker the main blast diaphragm operates the three phases of the interrupter elements

Centrifugal-Compressor Fundamentals

Centrifugals offer many advantages for low-pressure, large-volume compression. Here is basic information on design, performance and operation

▶ TODAY OUR NEEDS for compressed air and gases are many and varied, and the pressure to which they are compressed determines whether a centrifugal, rotary or reciprocating machine is to be used. The ASME test code classifies these machines as follows:

1. Compressors and exhausters are defined as those which, if used to compress air initially at standard atmospheric conditions, would increase the pressure by more than 1 lb per sq in. (27.73 in. of water).

2. Fans are defined as those which, if used under similar conditions, would increase the pressure by not more than 1 lb per sq in.

The classification of compressors and exhausters covers centrifugal blowers, centrifugal, rotary and reciprocating compressors.

Centrifugal machines have a pressure range up to and above 100 lb per sq in., depending on the number of impellers used. For pressures under 35 lb they are classified as blowers, and above are called compressors. They consist essentially of a casing in which revolves one or more impellers mounted on and supported by a shaft. Centrifugal force causes compression of the air and induces its flow to the periphery of the impeller. This tends to create a vacuum at the inlet which causes additional air to enter at this point. As the air passes through the impeller it is accelerated to a high rate of speed, and this velocity is then converted into additional pressure by gradual deceleration in the diffuser or volute which surrounds the impeller. The centrifugal force is dependent on the impeller speed as well as the density of the air or gas being compressed. An impeller, be it a pump impeller or a compressor impeller, will at a certain speed generate a certain head in feet, no matter what material is

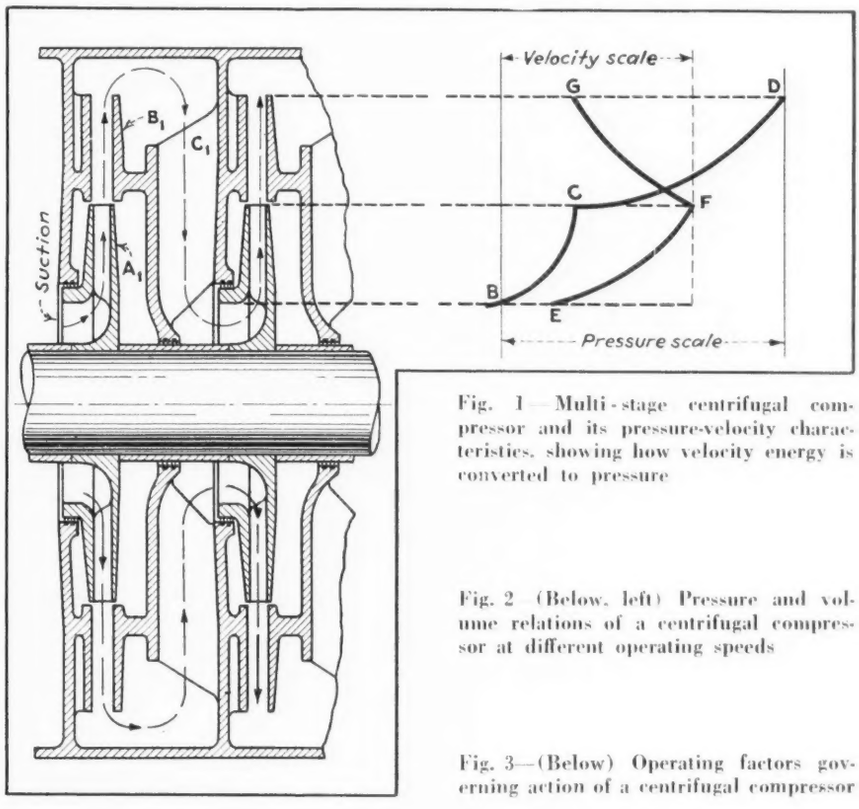
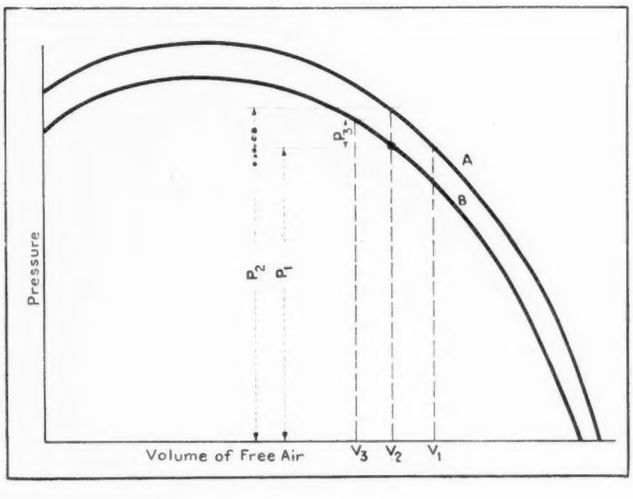
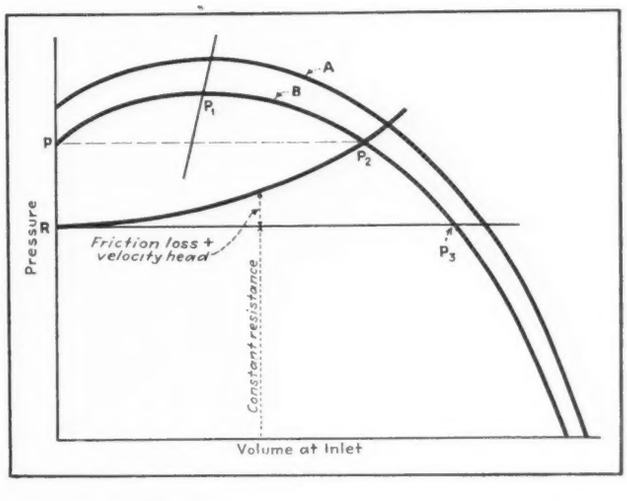


Fig. 1—Multi-stage centrifugal compressor and its pressure-velocity characteristics, showing how velocity energy is converted to pressure

Fig. 2—(Below, left) Pressure and volume relations of a centrifugal compressor at different operating speeds

Fig. 3—(Below) Operating factors governing action of a centrifugal compressor





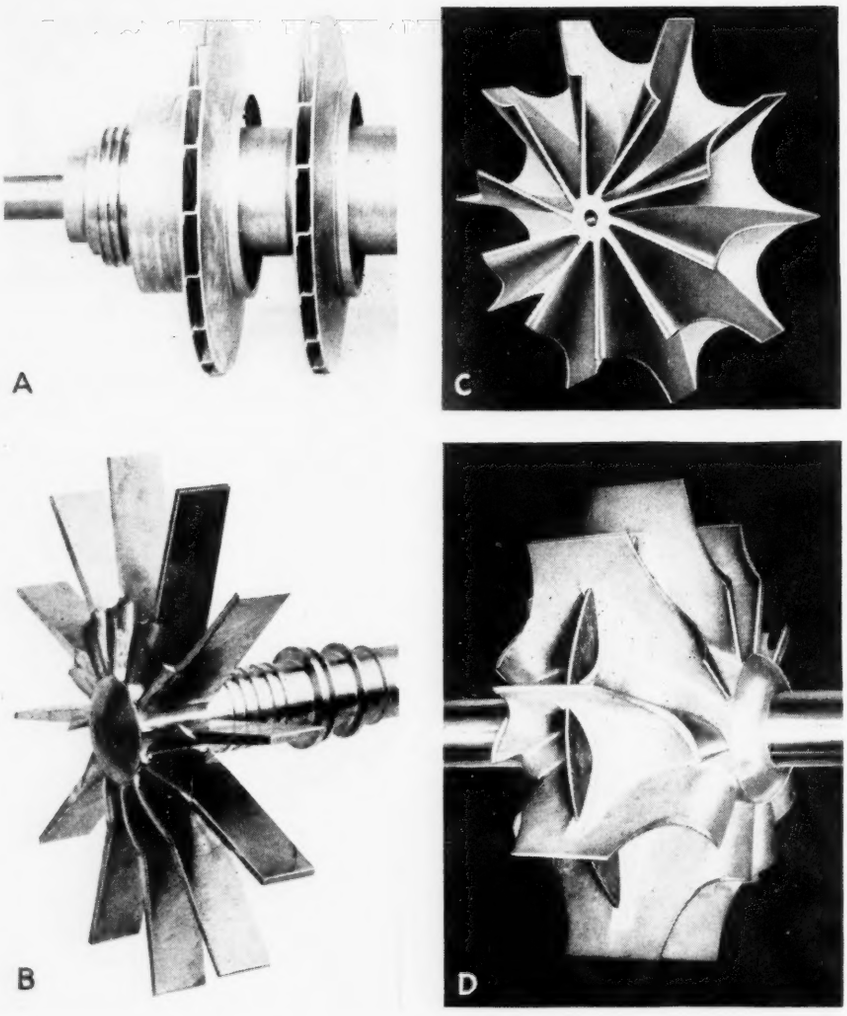


Fig. 4 A—Closed impeller, B—Radial-bladed open impeller, C—Semi-closed impeller, D—Double-inlet impeller. Variations of these designs are common

handled. For instance, a pump impeller giving a head of 100 ft of water will at the same speed, when handling air, give a head of 100 ft of air. However, the pressures in lb per sq in. will be entirely different, because of the difference between the densities of water and air.

Delivery of air or gas from a centrifugal blower or compressor is without pulsations, and produces no disturbance in piping systems. Automatic regulation for constant volume, for constant inlet or delivery pressure, or for constant mass rate of flow is easily accomplished. Dangerous over-pressures are impossible.

Centrifugals are compact and simple, have no internal valves, require no internal lubrication, and do not introduce oil or grease into the gas handled. Absence of rubbing parts, except bearings, keeps repair costs fairly low. Centrifugal compressors have their principal application where extremely large volumes of air or gas are required at pressures up to 100 lb. Although they can be built for pressures as high as 125 lb, their greatest range of usefulness is in the pressure ranges below 100 lb.

For applications where this type of machine has been adopted and where the pressure requirements are constant, regardless of size, ratings have been standardized. The capacity range is practically unlimited, machines have been built to handle volumes as high as 130,000 cfm. Operating speed range varies from 3000 to 10,000 rpm, which is considerably higher than that of most centrifugal pumps. They are available in the following types: Single-stage, single- or double-inlet; multi-stage, single- or double-inlet uncooled; and multi-stage single-flow water-cooled. Water cooling is generally used for pressures above 35 lb.

The operating principle and the characteristics of a centrifugal compressor can be explained through a study of Fig. 1. Air or gas enters through the suction opening and is drawn into the first impeller A_1. Centrifugal action of the impeller produces a pressure increase as shown by curve *BC*, essentially at a very high velocity as shown by *EF*, which is then converted into pressure *CD* in the diffuser B_1 and passage C_1. Curve *FG* shows the drop in velocity as energy is converted to pressure *CD*. The diffuser is a stationary passage of gradually increasing cross-section which surrounds the impeller and in which the kinetic energy of the air or gas is converted into pressure as its velocity is reduced.

Pressure-Volume Relation

If the head or pressure which is built up by a centrifugal compressor is plotted as a function of the volume, or delivery, curves such as *A* and *B* of Fig. 2 are obtained. Each curve is for a different compressor speed so from these curves we can see what relation speed has to pressure and discharge. Let one unit when running at speed *B* deliver a volume V_2 at pressure P_1. Then, let the speed be increased to a higher value as shown by curve *A*. The unit at this higher speed will then deliver the greater volume V_1 against the old pressure P_1 or it can deliver the old volume V_2 against the higher pressure P_2. At speed *B*, if we wish to reduce the rate of delivery from V_2, but cannot change the operating speed, the total head will have to be increased. If, for instance, the rate of delivery is reduced from V_2 to V_3, and the pressure P_1 is maintained, then the pressure P_3 must be dissipated by throttling at the discharge.

The various relations of the operating factors which govern the action of a centrifugal compressor are shown somewhat exaggerated in Fig. 3. In studying these characteristic curves we see that although difference in speed affects the pressure and volume output, the shape of the curves is identical. Two different speed curves are shown and as they are similar in shape we will discuss only the lower-speed curve *B*. At zero air discharge, the pressure *P* gradually increases to P_1 as the volume increases. Increasing the volume still further causes the pressure to fall to P_2, then P_3, and finally to zero at maximum discharge of the compressor.

Let the compressor be assumed as discharging through apparatus which creates a constant resistance regardless of the rate of flow. This constant resistance is represented by the line RP_3, while friction losses through pipes and valves in the distribution system, together with the velocity head, increases with the volume handled. Consequently, the total pressure follows a curve such as RP_2. A pressure-characteristic curve of this type compressor consists of that part of curve *B* between points *P* and P_2. As we study this part of the curve

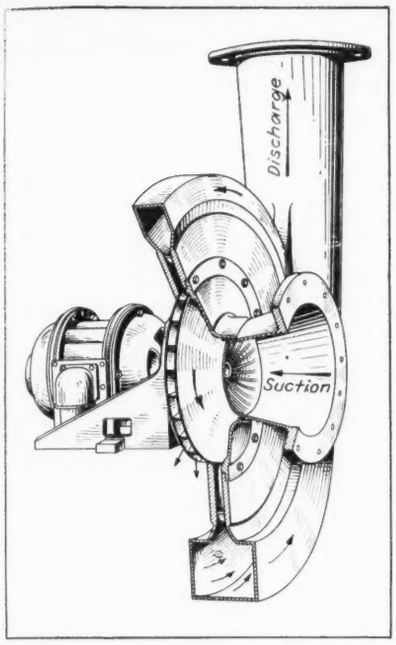


Fig. 5—Single-stage volute-casing blower

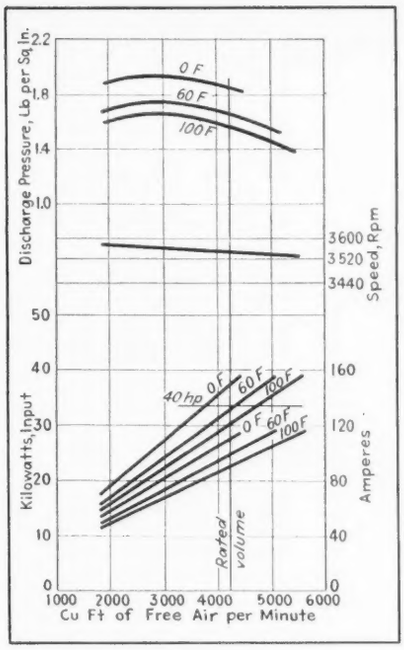


Fig. 6—How air temperature affects discharge pressure and power input of a centrifugal compressor

we find that if the volume is reduced we work back on the curve to point P_1 or point of maximum pressure. Any further reduction in output causes a reduction in pressure. The section between points P_1 and P is the area of "pumping" or unstable operation. At this point the machine no longer delivers a steady flow and air from the discharge side begins to flow back toward the inlet through the seals. As soon as the discharge pressure drops to the no-load pressure of the machine, the compressor again begins to deliver air. This intermittent delivery is accompanied by a muffled, puffing noise, and will occur along the curve from P_1 to P. Operation in this range can be made possible by the use of special control equipment.

Centrifugal machines rotate at high speeds, requiring the impeller unit to be perfectly balanced. Any slight unbalance will cause vibration which may become serious enough to wreck the machine. Repeated painting of the impeller may cause unbalance as it is impossible to spread the paint evenly. Compressors handling gas containing impurities may become unbalanced if the impurities are allowed to collect on the impellers.

Impeller wheels are designed according to their service requirements: radial-bladed, straight blades extending radially; backward-bladed with blades curved away from the direction of rotation; open, without inclosing cover and hub disk; semi-closed, closed on one side only; and closed, closed on both sides. Different impeller designs are shown in Fig. 4.

The cutaway view in Fig. 5 shows a shrouded, single-stage impeller in a volute casing. This is a typical low-pressure unit built to supply air in volumes up to 15,000 cfm at pressures up to 3 lb. The full-depth diffuser and ample-size volute assures maximum conversion of velocity energy to pressure. Leakage is kept at a minimum by the labyrinth seal between the casing and eye of the impeller. This is a single-suction impeller which requires that the end thrust be taken by properly designed motor bearings.

Performance curves in Fig. 6 show conditions that affect all centrifugal compressors. Pressure generated by a compressor is dependent on air temperature because this temperature is one controlling factor of the density or specific gravity of the air. From these curves it is apparent that a blower designed to handle air at a given pressure will not maintain the same pressure if it is used to compress some other gas not having the same specific gravity as air. For this same reason inlet air to the compressor should always be taken from the coolest location in or outside the plant. Another interesting feature is the slope of the power-input curve indicating the increase of power required as the volume output increases. This introduces danger of overspeed if the inlet becomes obstructed while unit is operating at full capacity. For this reason engine- and turbine-driving-unit governors should be kept in good operating condition. Overspeed does not generally occur with motor-driven units

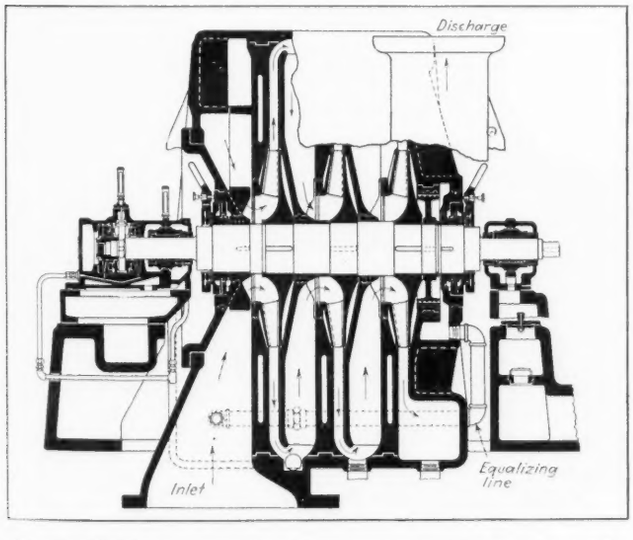


Fig. 7—Multi-stage centrifugal compressor with separate axial-thrust balancing disk on the rotor

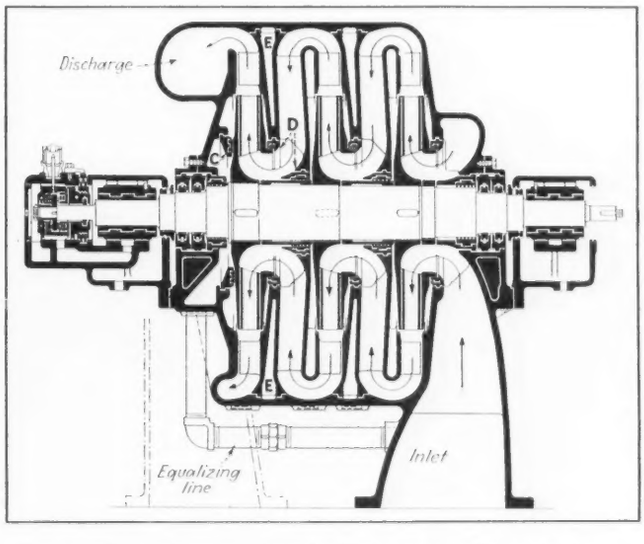


Fig. 8—This compressor uses the last-stage impeller as a balancing disk with labyrinth seal shown at C

because motors operating under normal conditions cannot exceed the speed for which they are designed.

Control systems vary depending on the service requirements. When the compressor is to operate in parallel with other machines a check valve must be installed in the discharge line to prevent reverse rotation while it is shut down. In order to prevent pumping at low loads a blowoff valve should be installed on the discharge which will open to the atmosphere when the system requirements fall off. Motor-driven compressors should be started with a closed discharge and this requires either a gate valve or a locking device on the check valve. With steam-turbine-driven compressors, the most economical method of automatic regulation is by varying the speed of the prime mover. With motor-driven machines, when the speed cannot be varied, the regulator can be made to operate a suction-throttle valve, or pre-rotation vanes. Pre-rotation or movable vanes are installed near the impeller inlet to change the direction of air flow to the impeller. This change of direction reduces the pressure rise through the impeller.

Different methods are used to overcome the impeller end thrust, although the principle of operation is the same. A separate disk or the last-stage impeller is used as a balancing disk with its outer side connected through a passage or connecting pipe to the suction chamber. In Fig. 7 the last-stage impeller is used and in Fig. 8 a separate disk is installed, with the connecting line illustrated in both cases. Pressure differential across the impeller causes an end thrust toward the inlet side. The equalizing line relieves the pressure from the outer side of the balancing disk which restores the rotor to axial balance.

Internal water-cooling passages are cast in the compressor casing with passages extending down inside the diaphragms. These passages are shown at *E*, Fig. 7, and are fitted with suitable clean-out plugs for flushing purposes. For high compressions the air is cooled by passing it through external coolers. In this arrangement the air is discharged from a series of stages through the cooler and back into another series of stages of the compressor. Aftercoolers remove the remaining heat of compression before the air is discharged into the distribution system.

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Will There Be Enough Power for Defense?

It is doubtful, says Leland Olds, FPC chairman, predicting that a power-supply crisis lies ahead. Here is a condensation of his November speech before the AIEE in Washington—see page 87 for a discussion by S A Tucker, associate editor

▶WE HAVE BEEN THROUGH a rather tough period, those of us who have realized from the beginning of the emergency how much power was going to be required. Men in a position to influence defense plans refused to think in terms of a long emergency and insisted that electric power supply had a low priority as compared with ships and planes and tanks and guns.

The industrial power to win can only be mobilized through a gigantic plan for the utilization of all of our resources, and the complete mobilization of all of our resources requires tremendous amounts of electric power.

The defense program cannot be limited to $36,000,000,000 a year, the figure we have set as the basis for power planning for 1943. By the time we reach 1943 our basis for defense-power planning may have been stepped up to $48,000,000,000 or even $60,000,000,000 a year. And every dollar of defense-power spending requires 2¾ kwhr of electrical engery.

In December, 1939, we held conferences with representatives of power systems serving important defense production areas. We estimated that the power systems would have to be ready to carry a war increment of 5,000,000 to 6,000,000 kw in case of complete mobilization. Men from many areas stood up and said that couldn't be, because if the production of all the manufacturing plants in their areas was raised to 100 percent there would not be demands such as we estimated.

But our 1939 estimates look small enough today compared with present estimates which place the 1943 defense load at closer to 10,000,000 kw. Billions of dollars are being invested in expansion of existing industrial plants and building of new ones. Billions more will be invested in the expansion of our productive power. Yet these expanded plant facilities would be useless without the electric power required to energize their machines and furnaces and pots.

The days are gone when men are treated with respect who say we have enough capacity to produce aluminum, copper, iron and steel, alloys, transportation or electric power.

We have recently seen our aluminum program expanded to envisage an ultimate production of 1,400,000,000 lb a year, the corresponding program for magnesium calling for 400,000,000 lb a year. And each pound of aluminum requires 10 kwhr of electric energy, while each pound of magnesium requires from 10 to 15 kwhr.

This means about 20,000,000,000 kwhr a year for defense aluminum and magnesium alone—equivalent to one-seventh of all the electricity used in the country for all purposes in 1940. And these metals mean bombers and pursuit planes.

The Federal Power Commission has been attempting to plan so that at no time will the national safety be jeopardized by lack of adequate and dependable power supply. This involves planning power supply before the defense plant which will use it has been conceived—for an industrial plant can be created in nine months to a year, whereas the additional power capacity required for its operation cannot be assured in less than two years from the date when it is planned.

Each month the Commission's defense power staff surveys the power requirements and supply situation in

the 48 power-supply areas into which the country has been divided. It records the trend in demand, estimates the probable growth in demand, determines the power supply which should be planned for and plots it against the available capacity, including new units, which will be installed in response to orders now on the books of the equipment companies.

Today demand is growing faster than capacity to supply demand and we are keeping track of the critical areas.

I need hardly call the attention of such an audience as this to detailed figures showing the extraordinary rate of growth. Most of you will have seen reports indicating that energy requirements for August were more than 17 percent over those of the previous August and that in the preceding 12 months demand had increased 14 percent.

In New England, exclusive of Maine, as well as in the TVA area, the demand in August was 22% over that of August, 1940. In the St Louis area, demand was up 23% over the previous year, while in the Bonneville northwest area the increase amounted to 45%. Other significant increases were 17% in the Pittsburgh area, from 16 to 18% in the American Gas & Electric belt, including parts of West Virginia, Ohio, Kentucky and Indiana, and 18% in the Carolinas.

Year-End Situation

A glance at the relationship between estimated peak loads for 1941 and the assured capacity available to carry those loads indicates that the year-end power situation will be very tight in at least half of the 48 areas into which the country has been divided—and this means the great majority of the more important areas from the point of view of defense industry. In many of these areas it will be necessary to cut into minimum reserves to carry the load. In some of these areas any delay in the installation of new units will render the situation more serious.

Projecting ourselves ahead to the end of 1942, we find that, in spite of the 3,223,000 kw of additional capacity scheduled for installation during the year, conditions will grow more critical. In fact, in 32 of the 48 power supply areas, the net assured capacity after allowance for minimum reserves will be insufficient to carry the estimated peak loads.

This means that by the end of 1942 two-thirds of the power-supply areas of the country's systems will be forced to encroach on reserves. In 14 of these areas, with all reserves in use to carry load, there will probably be insufficient capacity and a certain amount of curtailment may be necessary unless further regional pooling of reserves becomes possible. In another 10 of these areas the encroachment on reserves will range upwards from 50%.

It may be noted in passing that practically the entire region east of the Mississippi River will be short of reserves, the only important surplus being in the New York metropolitan area where, with reserves of 340,000 kw there is an indicated surplus of about 288,000 kw. This will be about enough to enable this area to carry the upstate New York deficit and provide reserves for the State, provided much heavier transmission interconnections are put in.

This situation brings us right up against a decision as to whether to plan for a reasonable minimum of additional capacity for each year through the emergency, or to follow the lead of some concerned with the defense program who are insisting that additional power units have a relatively low priority as compared with ships, planes, tanks and guns, who would not allocate essential metals to the construction of such units, and who hold that the country can depend largely on curtailment of normal use of electricity to provide the power for essential expansion of defense production.

Leland R Olds: ". . . by the end of 1942 two-thirds of the power-supply areas of the country's systems will be forced to encroach on reserves"

The Federal Power Commission has consistently taken the stand that the possible savings of power through curtailment should be reserved for emergency situations which cannot be met by planned additions to capacity, and that a minimum of additional capacity, equivalent to the ability of the equipment companies to produce land turbine-generators, should be planned for each year and given priority.

I have selected a number of the most important power supply areas to test the effect of freezing capacity at the levels which will be available at the end of 1941 and then asking the areas to carry the full estimated 1943 defense loads. The results are rather striking.

The curtailment of non-defense loads which would be required in these areas, assuming that no capacity is set aside for reserves to assure dependable operation, would be approximately as follows: New England, exclusive of Maine, 18%; upstate New York, with allowance of 120,000 kw from the metropolitan area, 55%; Pennsylvania-New Jersey pool, 14%; Baltimore-Washington pool, 36%; Pittsburgh area, 27%; Cleveland area, 40%; American Gas & Electric interconnected systems, 29%; Detroit-Michigan area, 6%; Chicago area, 18%; St Louis area, 26%; Commonwealth & Southern southeastern areas, 50%; Pacific Gas & Electric area, 40%, and the Southern California area, 16%.

Need for Caution

This may, in a sense, seem a reductio ad absurdum of the proposal to depend upon curtailment rather than planned additions to capacity to carry the defense loads, but it reveals the need for caution. For, in the first place, many of the curtailments indicated would be practically impossible on a sustained basis. And, in the second place, if attainable, the absolute lack of reserves would enforce curtailment of defense loads whenever a generator or even a major transmission outage occurred.

Actually, a similar situation will exist if the need for continued expansion of the defense effort extends into 1944 and 1945 and no plans are made for the orderly installation of additional turbine units for the years after 1942.

In view of the fact, which I emphasized to start with, that there are no limits to the requirements of modern war short of the maximum mobilization of our resources, we cannot afford to let such a condition develop. We cannot afford to face the possibility that a great need for expansion of munitions production will be thwarted by lack of electric power. Nor can we afford to face the possibility of excessive curtailment of non-defense use of electricity on a sustained basis.

The Federal Power Commission, therefore, sees no reason to change the proposal which it presented to the President on July 16th of this year, that

we assure an orderly program for the production of steam and hydro turbine-generators up to the capacity of equipment companies to produce such units. There appears to be a tendency in certain quarters to revive the theme of Mr C W Kellogg's swan song at the meeting of the Edison Electric Institute at Buffalo and to contend that the Commission's power program is "extravagant."

Those who listen to such siren songs are due for a rude awakening if the need for maximum defense effort is prolonged. We cannot afford to let the country's defense power plans be guided

by the same kind of shortsightedness as the Commission had to overcome in the early days of the defense program.

And we must not overlook the fact that droughts may occur in other parts of the country, that old equipment, when overworked continuously, will be increasingly subject to failure, that fuel supplies may be subject to interruption, that transmission interconnections may be interrupted, that acts of sabotage may occur, and that curtailment will then become inevitable. If adequate provision has not been made to supply growth of load, such curtailment will affect not only non-defense but also defense production.

Any proposal to reallocate the capacity of equipment companies to produce central-station units or the materials required for their production must be based on exceedingly cogent arguments which take into account the long range as well as the immediate requirements of a successful defense of our country against the tremendous industrial mobilization across the seas.

The Commission's approach to the problem has received sufficient publicity so that I need only recall here that it was based on defense expenditures which, by the end of 1943, will be running at the rate of $3,000,000,000 a month. It assumes that the country's energy requirements for 1943 will be 215,000,000,000 kwhr, or approximately those estimated for the Axis powers, and that this will mean a demand totalling about 43,000,000 kw, as compared with an actual 1940 demand of 28,000,000 kw.

Since the preparation of the Commission's defense power plan, there have been indications of still further expansion of the conception of what will be needed to defend America—a $50,000,000,000 a year program being the possible objective. If this materializes, the problem of assuring adequate power supply will be intensified.

But, tonight, instead of discussing at any length the plan for adding to our generating facilities, I want to face squarely the fact that, at best, we are not going to have in the next few years sufficient capacity to carry the load and provide an adequate margin of reserve capacity. For it seems to me that this fact, involving as it does the pooling of reserves, the best use of all capacity and the probability of curtailment in a number of areas, poses the most difficult problem of administering a defense power program.

By way of illustration I would like to outline briefly the way in which the critical situation in the Southeastern states was handled.

(Mr Old's outline of the history of the power shortage in the Southeast is omitted for lack of space—Editor)

General Possibilities

Certain generalizations may be made which are significant, not only in terms of the defense-power job but also in terms of the post-emergency period. They are that:

(1) There are possibilities in the way of coordination of generating facilities over wide areas which have not been realized in connection with present system set-ups;

(2) More high capacity inter-system transmission interconnection is desirable;

(3) These interconnections are needed in part because of the difficulty of determining sufficiently in advance precisely where additional blocks of power may be needed.

(4) The lines of demarcation between systems appear entirely artificial in terms of wholesale power supply and even as obstacles to assurance of adequate transmission interconnection and the best utilization of generating facilities;

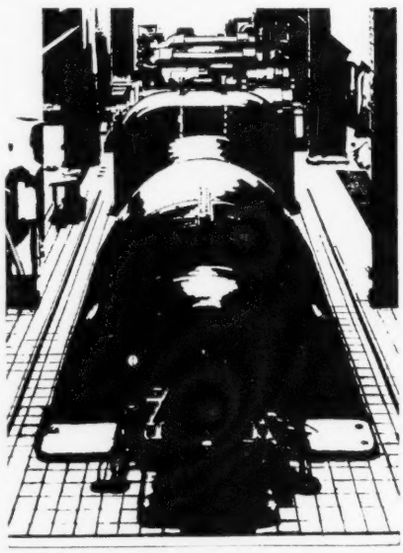
(5) Many power systems should be revamped, not only to permit firmer interconnection with other systems but also to make possible full utilization of existing fuel and hydro generating facilities within their own territory;

(6) Government supervision is a necessary factor in bringing about the maximum possible coordination of power supply over a very extensive region;

(7) Central load dispatching of power under government supervision has become necessary to secure best possible utilization of existing facilities.

Coordination and planning on a regional power supply basis must work smoothly and effectively if we are to get through the next two or three years without power shortages which cripple our defense program. And the government has got to take the responsibility for such coordination.

This leads me to speak, in closing, of the fine cooperation of the utility industry in meeting this emergency. Although utility leaders sometimes suggested rather pointedly that they



thought we were exaggerating the need, they have done a splendid job in meeting the need as we conceived it.

Men are already raising the question as to what we are going to do with all the electric power generating capacity when the defense emergency is over.

I answer, that if we accept the necessity of idle generators and idle transportation facilities, we must also accept the necessity for idle manufacturing capacity. And if we accept the need for idle manufacturing capacity we must accept the inevitability of idle men. And, if we accept the inevitability of idle men, the very institutions which we have defended will be in peril.

Coordination with Cooperation

A brief review of the other side of the power-shortage picture by S A Tucker, Associate Editor

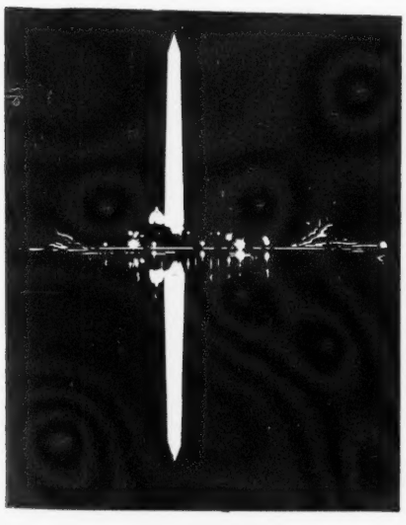
► ELSEWHERE IN THIS ISSUE, page 84, appears a condensation of a report on our national power preparedness by a responsible official of the government. Here are a few facts not included in that summary.

Last July the Federal Power Commission reported to the President a recommendation for a long-term construction program for new power units calling for placement of immediate orders for turbines, boilers and dams because of a threatened power shortage. Many orders for equipment were placed shortly thereafter by utility companies and by government authorities.

Load estimates of this report were predicated on the need for supplying six million kilowatts of load growth in 1941 and over five million more in 1942. The estimates were made after half of 1941 had passed and were based on the most complete collection of statistics ever compiled for this purpose.

Preliminary reports of 1941 peak loads indicate an increase of three and a quarter million kw. When the final figures are in, it will be found that just one-half of the expected load growth has been realized.

Would not the same basis of load estimating, if carried into the years ahead, result in diverting from other essential needs into power projects much precious copper, steel and labor?



Reviewing the year 1941, the net increase in generating capacity amounted to 2,712,000 kw. Since the load increased 3,250,000 kw, we "drew down" on our 10,000,000 kw of spare or reserve capacity to the extent of about 540,000 kw. We have used up 5% of our total reserves, not the 35% predicted by the Commission last July.

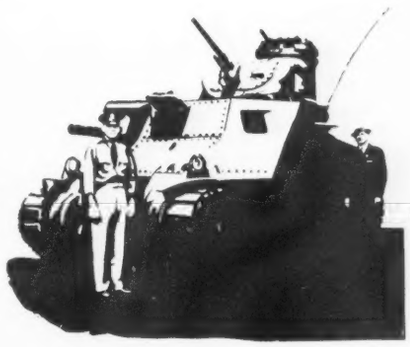
Perhaps industry will be geared to an even higher *rate of increase* in 1942. Perhaps the nation will experience five million or more kilowatts of load growth in 1942. To meet these loads, over three million kilowatts are scheduled for operation during the year. One-third or more of the turbines and equipment are already in process of field erection; most of the remainder is well along in the manufacturer's shops.

Nothing in the way of priorities, higher or lower, will greatly increase or reduce this total. Delays are inevitable under present conditions, but, because of the 1941 holdups, about 600,000 kw is nearly ready for operation, having originally been scheduled for 1941. These kilowatts were not included in the foregoing figures. For 1942, then, the chips are down!

Other phases of the country's war effort are in the grip of actual shortage. Metals, alloys, rubber, and skilled manpower are already being rationed by one method or another. Except for the drought in the Southeast, no need for power rationing has been experienced.

If the shortage in production of aluminum because of inadequate power in the Southeast is held up as a serious threat to our airplane production, we must consider two facts: (1) that aluminum plants can be built in less time than power facilities and (2) 420,000 kw of firm power has been available in New York City all during the shortage.

This available power could supply more than twice the Commission's estimate of the Southeast power shortage. If the aluminum emergency has been acute, why has not this ready-and-waiting power been utilized in the direct and immediate way of bringing aluminum refining to the power source?



Plans for transporting New York's power to Massena, aluminum-production center on the St. Lawrence river, are under way. Two schemes are offered (1) a 300-mile transmission line to be operated by the New York State Power Authority and (2) reinforcing the existing privately owned lines. The best information to date indicates that the latter proposition can be carried out in one-third the time and at one-third the cost of the former and would require less copper and steel. Which should be chosen by responsible officials of a nation at war?

Time and materials are essential elements in war. Unity of purpose and unity of program get first things done first, and others in orderly sequence. Would not a practical program include the following:

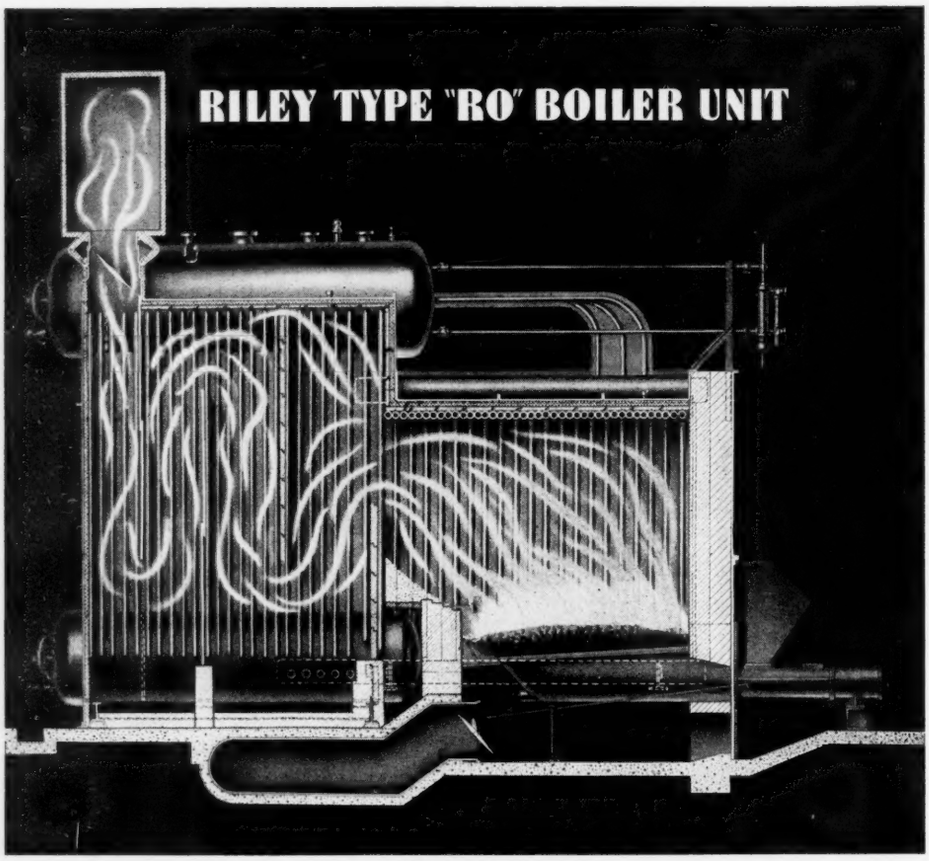
(1) Get all possible kilowatts from existing plant even if some strategic materials are thereby required,

(2) secure free and ready interchange of power between interconnected electrical systems as suggested by the engineers and dispatchers of the companies affected, without legal or government restriction,

(3) allocate turbine-building capacity to making machines for the most heavily taxed power areas, but only to the extent that land-turbine production will not delay the manufacture of naval and marine propulsion equipment.

Our single object should be concentration on the quick practical steps to assure power for the battle of production. This means complete elimination of all other issues.

The RILEY "RO" Boiler Unit has proven



FOR STEAM CAPACITIES UP TO 100,000 LBS. PER HOUR
Adaptable for Stoker, Pulverized Coal, Oil, Gas or Wood Firing

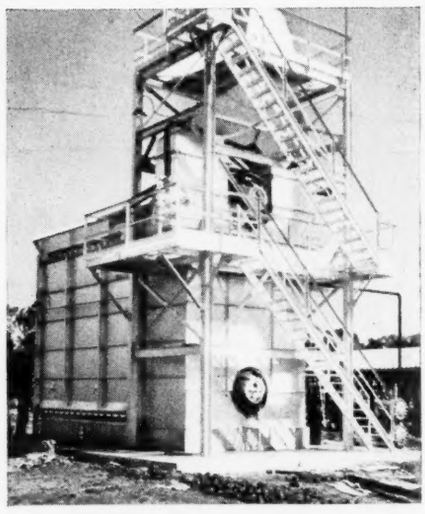
Convinced that high quality of design and performance is as desirable and as important in moderate sized boiler units as in large units, Riley engineers developed the Riley "RO" Boiler Unit. This is sound business logic for, after all, a boiler is actually a tool for producing steam, as much so as any tool in any manufacturing process, and nowhere can a cheap tool be justified.

That is why Riley has adhered so firmly to maintaining only the highest standards in the construction of the Riley "RO" Boiler. If instead of using 10¾" water wall headers, headers of smaller size were used; if instead of using forged hand hole caps, key caps or plugs were used; if instead of using 3¼" O.D. water wall tubes, 2½" or 2" O.D. tubes were used; if instead of using a No. 10 gauge flanged steel casing, a lighter batten strip casing or a plain refrac-

Excellence in Performance and Construction has resulted in rapid acceptance of Riley "RO" Units

A FEW USERS:

American Brass Co.
A. O. Smith Co.
U. S. Gypsum Co.
Monsanto Chemical Co.
Pet Milk Co.
American Steel & Wire Co.
Mead Corporation
Goodyear Tire & Rubber Co.
Armour & Co.
Curtiss Wright Corp.
Penn. Salt Mfg. Company
Amer. Water Wks. & Elect. Co.
Nicholson File Co.
Modine Company
Scovill Mfg. Co.
Hercules Powder Co.
Carnation Milk Co.
A. C. Lawrence Leather Co.
Worcester Gas Light Co.
Revere Copper & Brass Co.
Publicker Comm. Al. Co.
Wickwire Spencer Steel Co.
Republic Creosoting Co.
Great Western Sugar Co.
The Bullard Co.
Std. Oil Co. of Calif.
Nunn Bush Shoe Co.
Pepsi Cola Co.
C. G. Conn Co.
General Aniline Wks.
Breyer Ice Cream Co.
Peninsular Plywood Corp.
Amer. Hoist. Derrick Co.
Heyden Chem. Co.
Holly Sugar Co.
Smith Paper Co.



40,000 lbs./hr. Riley "RO" Boiler outdoor installation

Because Riley "RO" Boilers are encased in a steel-clad setting, they are particularly well adapted for outdoor installations.

RILEY

STOKER CORPORATION, WORCESTER, MASS.

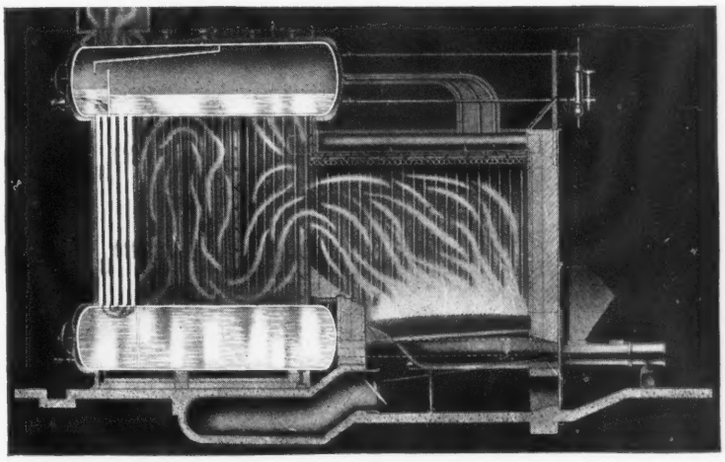
Boston New York Philadelphia Pittsburgh Buffalo Cleveland Detroit Seattle Portland Baltimore Richmond
Denver St. Louis Cincinnati Houston Chicago St. Paul Kansas City Los Angeles Atlanta Memphis New Orleans

It will pay you to visit modern Riley Installations

itself a worthy member of the Riley Family

tory setting were used, the Riley "RO" Unit could be sold at a lower price, but the purchaser would get what he paid for, a cheap tool.

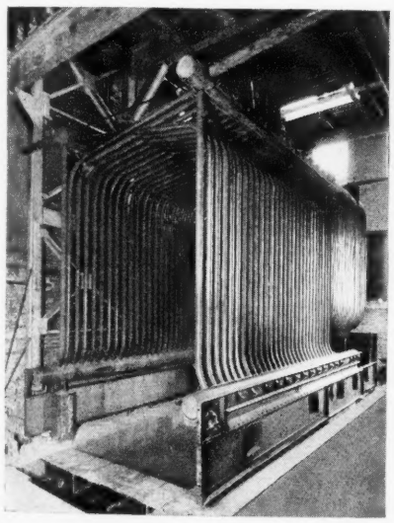
The enthusiastic commendation by users and spontaneous acceptance by the engineering profession has fully justified Riley's determination to maintain in the "RO" Unit the same high quality of design and construction as found in other Riley products. It pays to buy the best. When purchasing moderate sized boiler units, it will pay you to check all features of design against what would have been offered if units of larger sizes were being purchased.



Riley "RO" Boilers are equipped with integral economizer.

Why are efficiencies so high with Riley "RO" Boilers?

Rapid circulation of water, together with proper baffling of gases, assuring the most effective heat transfer, with resulting low flue gas temperature, is one reason for the high efficiency being obtained from Riley "RO" Boilers. Another is the use of an integral economizer. Feed water before entering the boiler section must first pass down and then up through a series of tubes. Because of the lower temperature of the feed water, the gases give up a greater amount of heat than they would passing over even a much greater amount of boiler heating surface. And still another reason is that with the water-cooled furnace, combustion conditions can be maintained at the most efficient point without clinker or slag difficulties. Following are a few typical results being obtained in the field with Riley "RO" Boilers.



The Furnace is Water Cooled

Typical Results with Riley "RO" Boilers

OIL FIRING

Geo. O. Jenkins Co., Bridgewater, Mass.	83.4%
Heyden Chemical Co., Fords, N. J.	83.2%

STOKER FIRING

State Capitol Heating Plant, Raleigh, N. C.	82.7%
Pet Milk Co., Coldwater, Ohio	81.7%

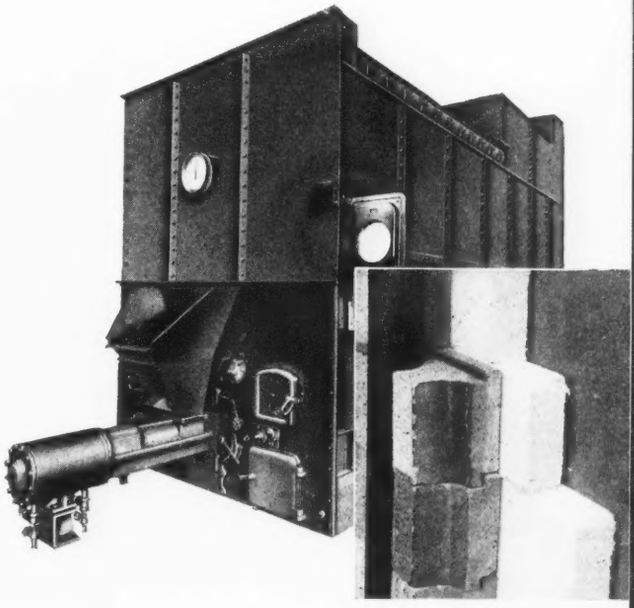
GAS FIRING

Monsanto Chemical Co., Nitro, W. Va.	78.4%

Why is maintenance negligible with Riley "RO" Boilers?

By installing water wall tubes at the side walls, temperatures to which the refractories are subjected are sufficiently low to eliminate the problem of refractory maintenance. The use of an insulated steel casing, preventing leakage of air into the setting which normally occurs with a plain refractory setting, eliminates this maintenance problem. With rapid positive circulation in the boiler, heat is rapidly carried away by the boiler water, reducing scale formation and minimizing the possibility of tube failures. The use of water walls reduces the severity of service to which the radiant boiler tubes are subjected, placing part of the work performed by this section of the boiler, in the case of a refractory furnace, upon the water wall surface. Because of these various factors maintenance has been inconsequential with Riley "RO" Boiler.

A survey of your power plant by a consulting engineer will possibly show ways of making surprisingly large savings in power costs



Steel Clad Insulated Setting is Used.

COMPLETE STEAM GENERATING UNITS

BOILERS • PULVERIZERS • BURNERS • STOKERS • SUPERHEATERS
AIR HEATERS • ECONOMIZERS • WATER-COOLER FURNACES
STEEL-CLAD INSULATED SETTINGS • FLUE GAS SCRUBBERS

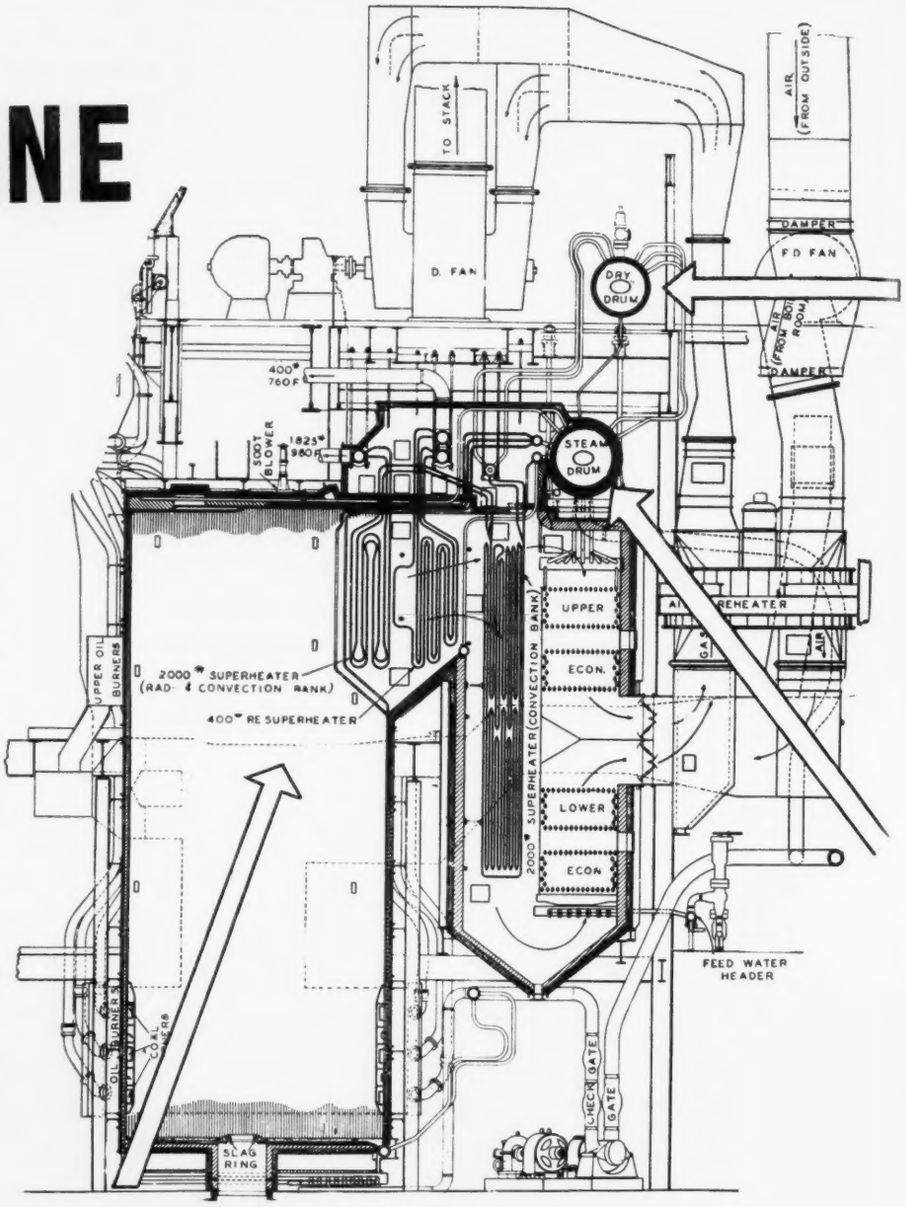
before purchasing Boiler or Fuel Burning Equipment

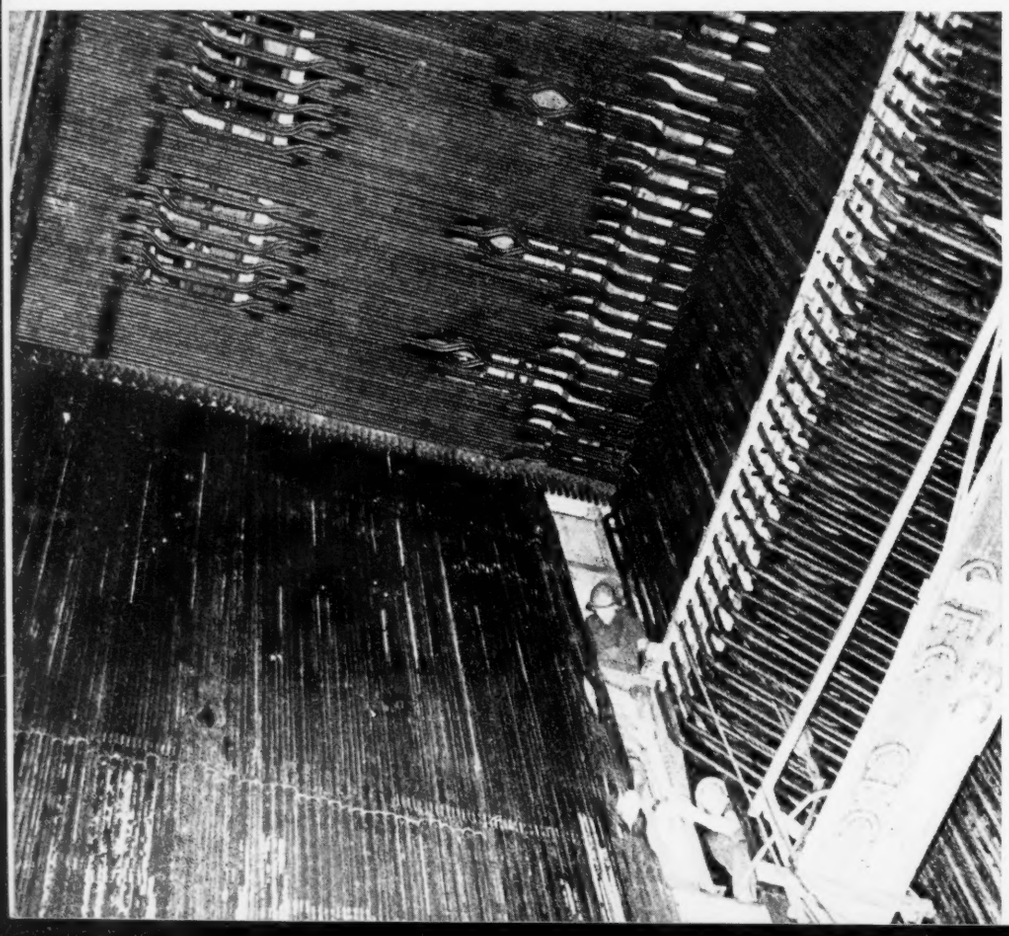
WELD DONE

First U. S. Forced-Circulation Boiler Nears Completion

● WITH THE COMPLETION of a 650,000-lb-per-hr, 1825-lb, 960-F controlled-circulation steam generator for the Somerset station of the Montaup Electric Co next spring, this country will have its first experience record with a type of boiler construction (POWER, December, 1939, page 85) markedly different from present standard designs. Built by Combustion Engineering Co, this boiler has no rolled joints, makes maximum use of welding of boiler, water-wall and superheater tubes as well as drums, and controls water circulation to each tube by an orifice at its entrance.

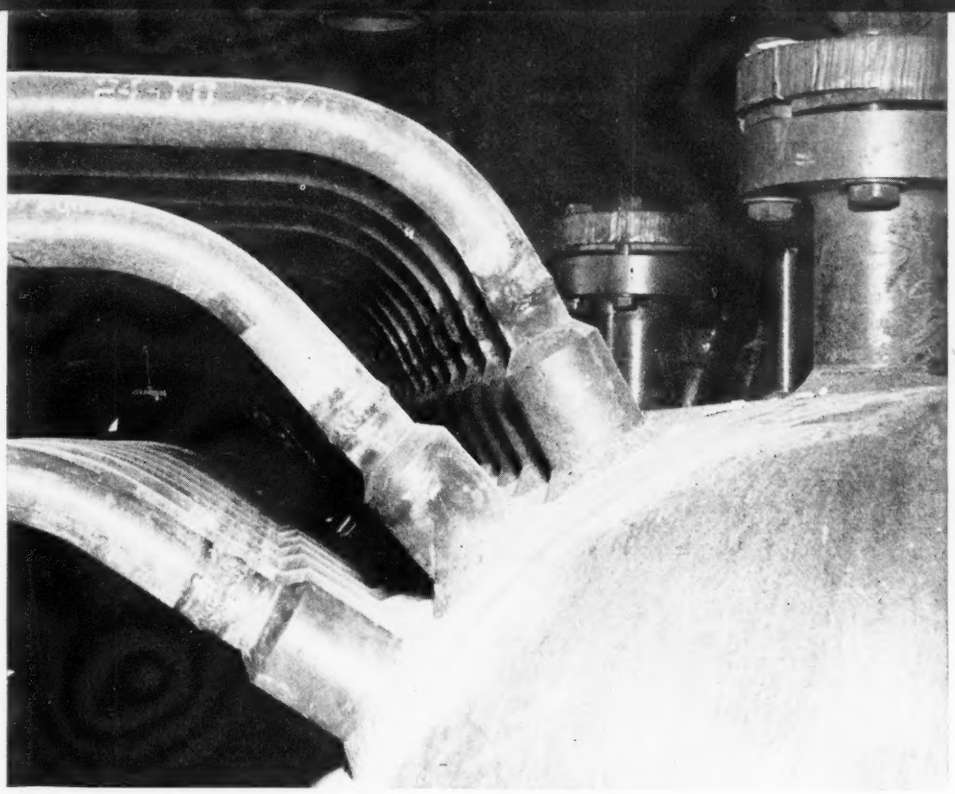
Designed for reheat to 765 F at 370 lb, the new boiler and its accompanying 25,000-kw turbine top the existing condensing turbine plant. The boiler drum, only a few feet above the furnace roof, is 43 ft long and nearly five inches thick, all welded, including stub ends for all downcomers and tubes.





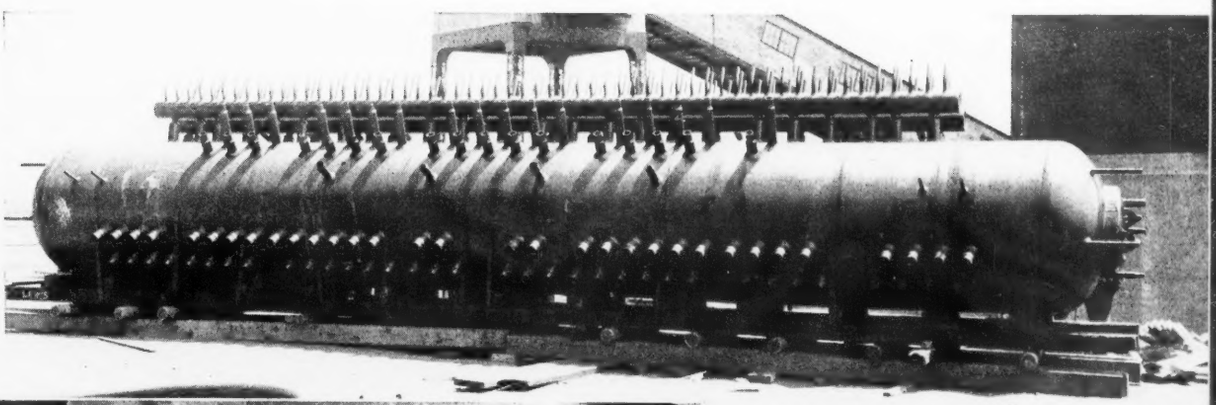
A VIEW UPWARD into the unfinished furnace shows roof, screen and sidewalls of 1¼-in. OD tubing which were shipped in 2-flatcar lengths. Some of the tubes, forming the floor, were jig-bent on the job. Furnace will be tangentially fired with pulverized coal from an existing storage system, supplemented by oil. Furnace bottom is arranged for continuous slag discharge.

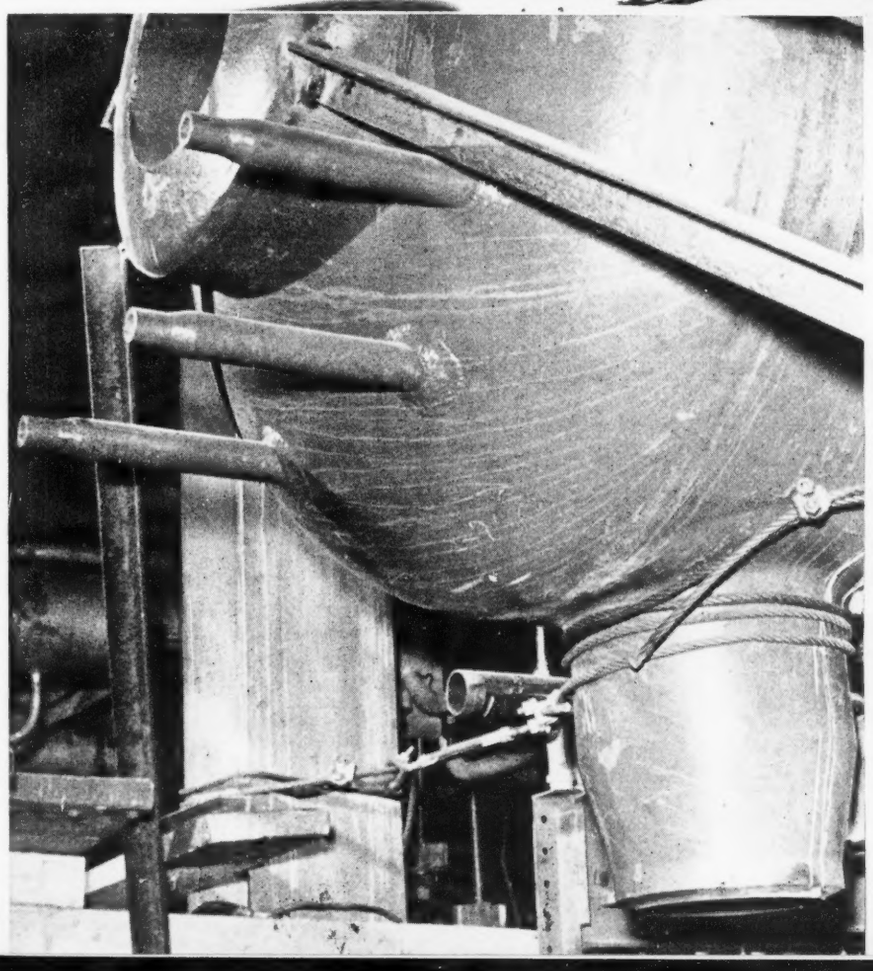
A 2-stage superheater with temperature-control bypass dampers, a reheat section, Elesco fin-tube economizer and regenerative air heater form the entire convection surface, all saturated surface being radiant.



A VAST NUMBER of field welds join the many small furnace tubes as well as the dry-drum circulators shown here. Attachment of stubs to drums in the shop keeps field welding several inches from the drum proper.

Bifurcated wall tubes each contain an inlet orifice for control of boiler-water flow. These orifices are kept from plugging by an ingenious strainer that can be removed if necessary.





THE 72-TON DRUM, 54 in. ID, has but two downcomer connections that supply three circulating pumps. Each can pump 1,400,000 lb per hr at 50-lb pressure, many times the head that could be obtained from natural circulation at high pressure. Two of these overhung-impeller Ingersoll-Rand pumps have dual drive with motors and Terry turbines; the third is motor driven only. Pump power is 0.3% of plant output and the entire water content circulates about once each minute.

Saving FUEL,

Easy TO INSTALL...

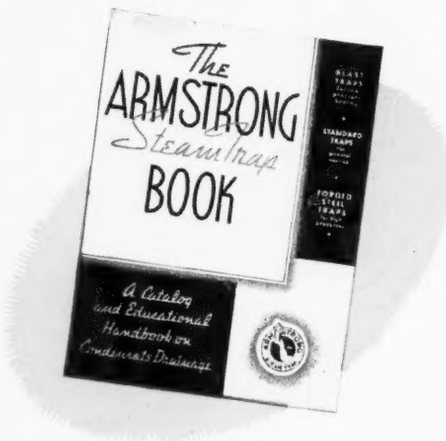
• 3,470,000 cu. ft. of gas saved in a month by 17 Armstrong traps installed at the Heineman Chemical Co., Crosby, Pa.! 800 gallons of fuel oil saved in a week by 16 Armstrong traps just installed at Midland Chemical Laboratories, Inc., Dubuque, Iowa! A ton of coal saved a day and 95% reduction in maintenance credited to 50 traps put in by R. Thomas & Sons Co., Lisbon, Ohio.

These are just a few of the many reports of benefits secured. What this means to a nation now bending every effort to get maximum results out of every unit of fuel, metal and manpower can be better visualized by translating it into terms of Armstrong's annual output of traps.

14,000 cars of coal . . . 68 five thousand ton shiploads of oil might otherwise be expended for non-productive work. As much as 10,000,000 pounds of steel might be required for extra boiler capacity to burn the fuel and generate the steam going into this non-productive work. And to the accompanying expenditure of manpower would be added thousands of hours for maintenance of old traps and drainage systems.

ARMSTRONG TRAPS PAY FOR THEMSELVES MANY TIMES OVER IN SAVINGS OF FUEL, METALS, AND MANPOWER.

ARMSTRONG MACHINE WORKS
812 Maple Street **Three Rivers, Michigan**



ASK FOR A COPY OF THE ARMSTRONG STEAM TRAP BOOK

THOUSANDS of engineers use this book to get all information needed to handle ordinary piping, heating, and drainage engineering jobs. It contains a wealth of tables, charts, curves, diagrams, etc. We will be glad to send you a copy without obligation.

SEE OUR CATALOG IN SWEET'S

USE

ARMSTRONG

METALS and MAN POWER

Easy TO INSPECT!

BUILT FOR YOUR CONVENIENCE

1. **PIPE CONNECTIONS IN BODY — NOT IN CAP.** Armstrong "300 Series" Side Inlet Traps embody the advanced design pioneered by Armstrong. Never any need to break pipe connections. Merely by loosening the cap, the entire operating mechanism is free to lift out for easy, convenient inspection.

2. **CHOICE OF BODY STYLES.** As the job dictates, you are free to choose the body style that fits in best with your piping arrangement: "800 Series" side inlet traps are popular for horizontal piping runs, "200 Series" bottom inlet traps for vertical runs — particularly where trap discharges to an overhead return line.

3. **NO PRIME-HANDLING NUISANCE.** In neither type of Armstrong trap are you presented with any problem of disposing of a body full of hot prime when you want to open up a trap. In both types, the body stays in the line.

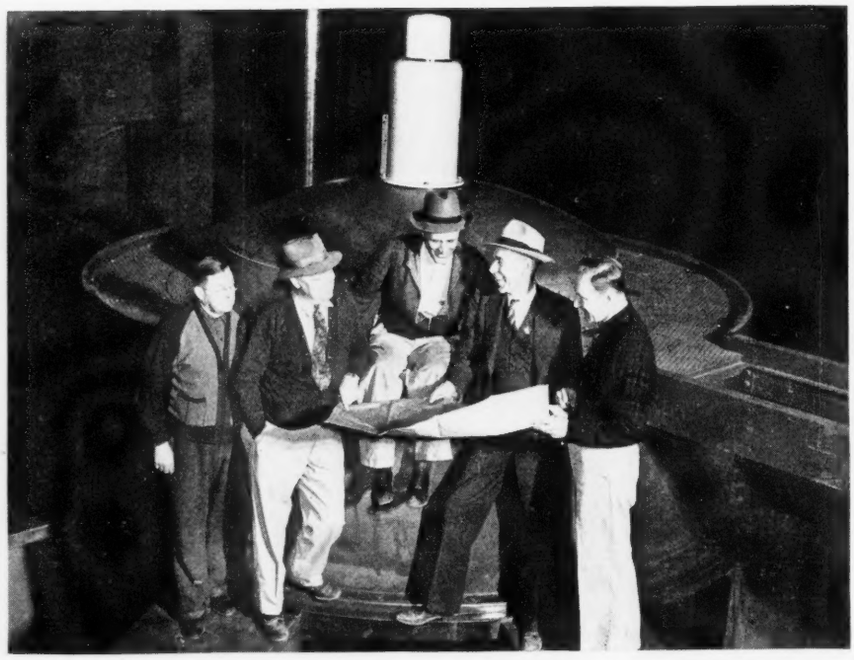
4. **EASY TO TEST OPERATION.** All Armstrong Traps in the 200 and 300 Series have test plugs located directly over the discharge orifices. Few users ever need this feature but it's there for your convenience!

5. **SELF-SCRUBBING . . . NON-AIRBINDING . . . ALL-STAINLESS STEEL INTERIOR MECHANISM.** These are all features that protect you against annoying time waste and expense.

STEAM TRAPS

Master Craftsmen Erect Grand Coulee

Four engineers, totalling over 100 years' experience, supervise erection of world's largest hydroelectric units at Grand Coulee power plant



Left to right, Sam P Fisher, Westinghouse, assembly foreman; F J Malarkey, Newport News, turbine-erection engineer; H Walter Berkley, Westinghouse, erection superintendent; F A Smith, Woodward Governor, erection engineer; and J A Kadletz, General Electric, transformer-erection engineer

► MORE THAN 100 YEARS of experience erecting giant hydroelectric machinery in all parts of the world is being contributed at Grand Coulee power houses by the contractor's engineers who are supervising the assembly of the hydroelectric generators and their control and transformer equipment. Machinery consisting of six 150,000-hp turbines, six 108,000-kw generators, six waterwheel governors, and 15 mammoth transformers, costing $10,400,000 and weighing about 12,726 tons, will be installed under the direction of a quartet representing some of the largest builders of powerhouse machinery in the United States.

Equipment contracted for represents only about one-third that required to complete the two power houses designed by and being built under direction of the U. S. Bureau of Reclamation. Each power house will hold nine 108,000-kw machines, which will be served by two rows of 27 transformers, each transformer 20 ft high, 20 ft long and 12 ft wide. The master craftsmen are: J A Kadletz, transformer-erection engineer for the General Electric Co; F J Malarkey, turbine-erection engineer for the Newport News Shipbuilding and Drydock Co; F A Smith, erection engineer for the Woodward Governor Co, and H Walter Berkley, erection superintendent for the Westinghouse Electric and Mfg Co.

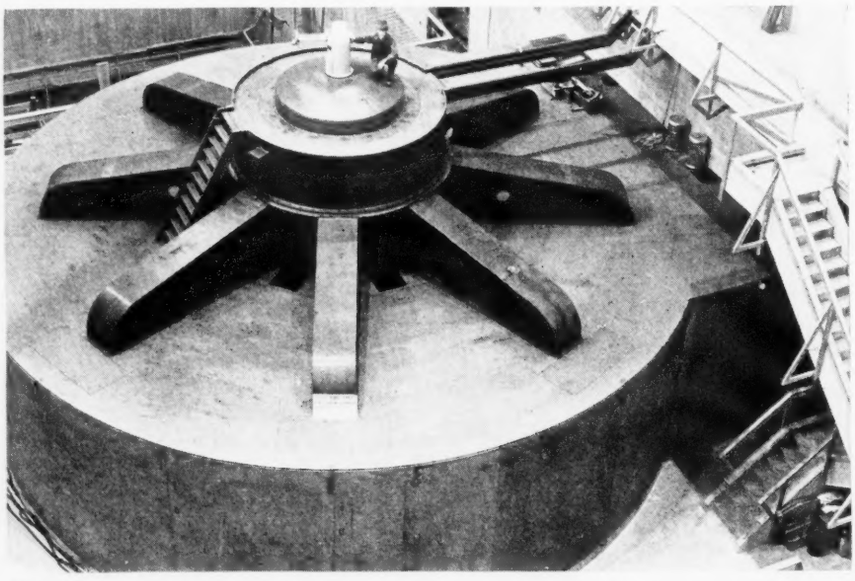
Each machine weighs about 1750 tons. A vertical steel shaft, 44 in. in diameter, 74 ft long, weighing nearly 200 tons, connects the 587-ton generator rotor with the waterwheel. The entire revolving section (wheel, shaft and rotor), weighing about 800 tons, is suspended from an 8-ft Kingsbury thrust bearing, seated on a heavy structural-steel bracket resting on the generator stator.

Westinghouse generators are three-phase, 60-cycle, 13,800-volt, 120-rpm, vertical-shaft, totally inclosed, air-cooled machines, rated at 108,000 kw at unity power factor. Guaranteed efficiencies range from 93.4% at 25% load to 97.4% at full load. Each generator is inclosed within a housing 45 ft in diameter.

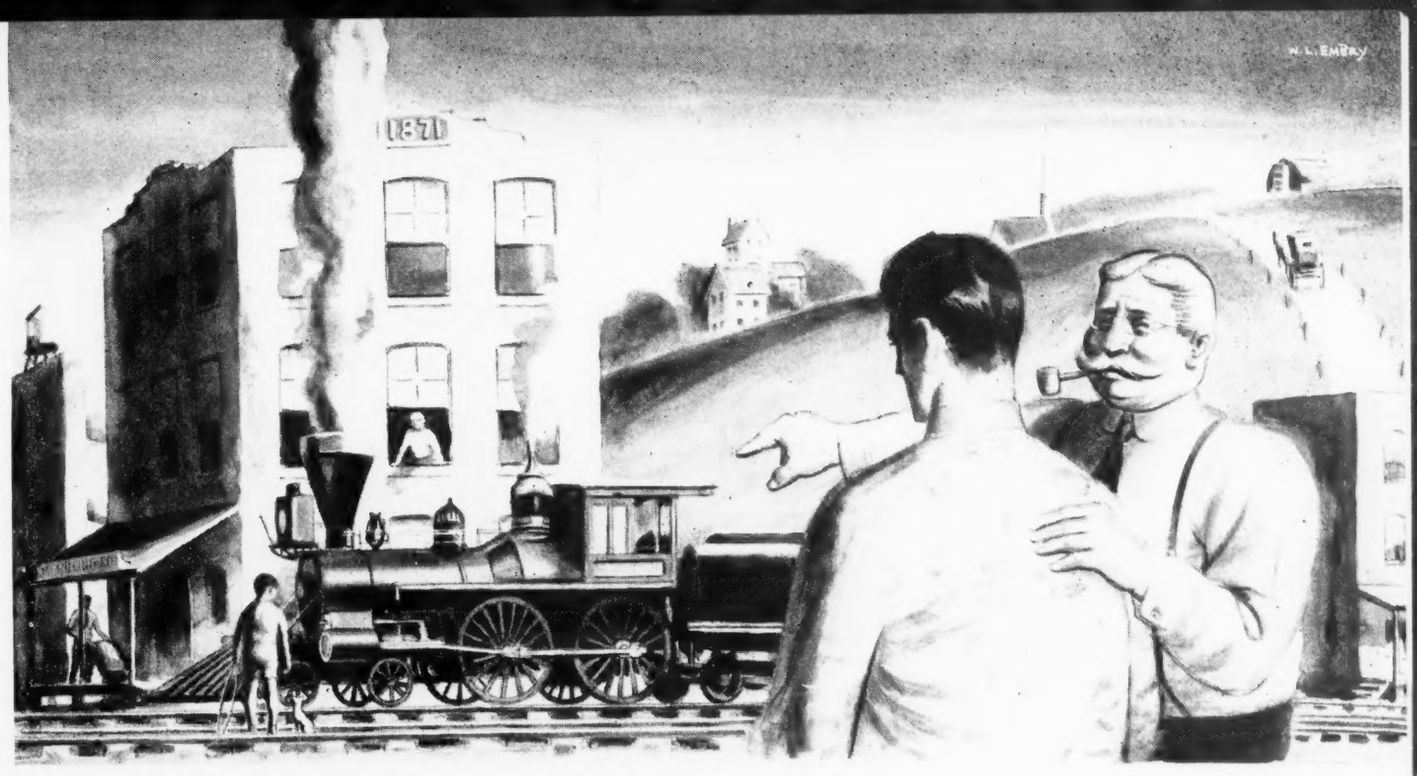
Turbines are Newport News Francis type, operate at 120 rpm, and are rated 150,000 hp at 330-ft head, and 90,000 hp at 263-ft minimum head. Efficiencies of 90% or over are guaranteed at 120,000- to 130,000-hp loads.

The 290-ton turbine scroll cases, buried in concrete, are under an internal hydraulic pressure of 145 lb per sq in. and have an overall diameter of 51 ft, 5½ in. Penstocks are 18 ft in diameter. Each turbine runner is a single steel casting, 16 ft, 6 in. in diameter, with 19 vanes, and an entrance height of 34⅜ in.

Transformers are General Electric 36,000-kva oil-immersed, water-cooled inert-gas-filled outdoor-type, with 13,800-volt, delta-connected primaries, and 230,000- and 115,000-volt wye-connected secondaries. Each generator is connected to three transformers. One set of three transformers will be provided with both 115,000- and 230,000-volt secondary windings.



This unit, rated 108,000 kw and first of 18 to be installed, has 30% greater capacity than any other hydroelectric unit previously built



. . . the engine was on the siding and the mill was humming away . . .

The Old Chief

XIV—The Borrowers

Fourteenth in a series by William Doran, chief engineer, Essex County Sanatorium, Windsor, Ontario. Writing of the inspiration of the past, he has captured much of the human side of engineering

We kept a very complete and up-to-date kit of tools in the old plant, but I often wondered if they were our own, or community property. All the other plants in town borrowed them from time to time. As long as they brought them back in good shape, the Old Chief never refused. I remember that we loaned a wheel puller to one firm and they broke it on a job, replacing it with a new and heavier one. Some time later they borrowed it back; again they wrecked it, and replaced it with a still heavier and more elaborate one, which was all very good business for us.

The tools most in demand were ratchet drills, chain slings, blacksmith's forges and tongs, chain falls, jacks and sledge hammers and I don't recall that we ever lost one article. Not only did they borrow *tools* from the Old Chief but they borrowed plenty of experience and advice from him. He was never too busy to talk shop with young or old engineers who came to borrow.

One Monday morning I was in the office checking over the night-shift charts, when a very excited man in overalls rushed in, whom I recognized as the engineer from the steam laundry down the street. He asked me if I would phone the Old Chief and request him to stop in at the laundry on his way to the plant.

When I asked him why he did not phone from his own place, he replied that there was something "screwy" about his boiler and he did not want the "nosey so and so's" in the laundry to know anything about it.

Later on when the Old Chief came on duty he told me what the trouble was. It appeared that they were in the habit of banking the fires in their hrt boiler over the weekend and on Saturday afternoon someone thought that it would be a good idea to use up the remaining steam in the boiler to dissolve a large tank of soap. *But they did not wait to shut off the valve when the soap was dissolved*, with the result that it siphoned back into the boiler. I asked if the manager of the laundry had found out about the incident. The Old Chief laughed, "He certainly had, and I don't know who is foaming at the mouth most, the old man, or the old boiler!"

We gleaned many gems of quaint psychology from those who came a-borrowing. I remember one powerfully built and begrimed old fellow, who liked to regale us with stories of what *he* told the men whom he termed the big "Muckety Mucks" down at the plant where he worked in the boiler room.

"I was sitting smoking me pipe in the boiler room," he would say, when in walked Mister Manager himself. 'Have ye nothing better to do than sit there, me man?' says he. I says to him I happen to be saving you money, because when I'm sitting here I'm not throwing coal on the fire."

Speaking of psychology, there was the story of how the chief engineer of one of the mills in town obtained a very much-needed standby boiler. In this plant the management had added to the factory every year, until the one lone hrt boiler was loaded beyond all reasonable limits. One fine day the back arch "fell in" and it looked like the mill would be closing down with a very heavy financial loss. The chief immediately got busy and discovered that there was a locomotive in the railway yards, that was booked for mechanical repairs, but had a boiler which was all right. A call to the yard foreman brought the reply that it could be rented. So within a very short time the engine was on the siding outside the boiler room and the mill was humming away while a new rear arch was built. On the day following, tenders were asked on a new, additional boiler.

"The whole thing was very remarkable," the Old Chief said, "especially the fact that Tom Martin, the yard foreman, is a brother-in-law of the chief at the mill. It is also remarkable for a back arch to "fall in" on a man of his experience, without his knowing about it going to do so. Mind you, I don't say that he helped that back arch on its way, but I do know that his desk happened to be stuffed with literature from every boiler maker in the business."

Adequate Lubrication Keeps Anti-Friction Bearings Rolling

At this time when every machine operates at peak capacity, bearings must be adequately lubricated to guard against failure and to conserve power. Here is how it is done with ball and roller types used on a wide variety of equipment

By JAMES I CLOWER
Associate Professor of Machine Design, Virginia Polytechnic Institute

▶ SUCCESSFUL AND ECONOMICAL operation of machinery equipped with ball or roller bearings depends on correct bearing lubrication. In these days when nearly every machine is operated at peak capacity, it is vitally important that bearings be given such attention, not only to guard against failure and short life but also to conserve power.

A lubricant in a ball or roller bearing performs a 4-fold duty: 1, it protects the finished and highly polished surfaces from rust and wear; 2, it reduces friction between stationary and moving parts; 3, it aids in the dissipation of heat resulting from deformation of loaded parts and from friction; and 4, it generally forms a supplementary seal between stationary and rotating parts which prevents dust and dirt from entering the bearing.

Care of Lubricants

Lubricants for ball or roller bearings obviously should be free from abrasive materials. Rarely do lubricants contain such materials when they leave the refinery, but in many instances they become contaminated through careless handling by users. Drums and other containers are left uncovered; gun fittings are seldom, if ever, cleaned; and oil retainers and seals are neglected, permitting dust and dirt to enter the bearings. In repair work, bearings are frequently washed with dirty gasoline containing rust, sand, and other abrasive materials.

Solid matter not of an abrasive nature tends to clog oil passages and ducts and the bearing itself, causing excessive wear and friction and interfering with the free action of the balls or rollers. Gummy deposits formed from oxidation of the lubricant when subjected to high-temperature and speed conditions act in a like manner.

Moisture is detrimental to ball and roller bearings, and its presence even in small quantities will cause rusting. For this reason, lubricants used for these bearings should be strongly resistant to moisture absorption.

In selecting a lubricant for ball or roller bearings, consideration should be given to housing design, operating temperature, speed, load, size, and method of applying the lubricant.

Housings for ball or roller bearings vary in construction, depending mainly on whether oil or grease is to be used for lubrication. Oil is a more efficient lubricant for these bearings than grease because of its lower frictional resistance. It is, however, more difficult to prevent leakage of oil from the housing. Oil, therefore, requires a more complex and expensive housing. Moreover, oil is not so effective as a supplementary seal and requires more frequent attention.

The question of operating temperature is of prime importance, for oil viscosity and grease consistency decrease rapidly as temperature increases. A lubricant that may be perfectly satisfactory at normal temperature would probably be unsuitable at a lower or higher temperature. Surrounding temperatures

Table I—Guide To Selection of Ball- and Roller-Bearing Oils

Type	Operating conditions		Body of oil	Viscosity, SSU		
	Temperature, F	Speed, rpm		100 F	130 F	210 F
Ball Bearings	Under 32	Any	Light*	126	73	42
	32–110 (Normal)	3000–15,000	Extra-light	64	48	36
	"	300– 3000	Light	126	73	41
	"	50– 300	Heavy	285	128	47
	"	Under 50	Medium-heavy	380	160	51
	110–130 (High)	Over 3000	Heavy	285	128	47
	"	300–3000	Medium-heavy	380	160	51
	"	Under 300	Extra-heavy	505	200	55
	Over 130 (very high)	Any	Steam-cyl oil	1950	775	110
Roller Bearings	Under 32	Any	Light*	126	73	42
	32–110 (Normal)	300–3000	Light	126	73	42
	"	50– 300	Heavy	285	128	47
	"	Under 50	Medium-heavy	380	160	51
	110–130 (High)	Over 3000	Heavy	285	128	47
	"	300–3000	Medium-heavy	380	160	51
	Over 130 (very high)	Any	Steam-cyl oil	1950	775	110

** This oil should have not less than −15 F pour point.*

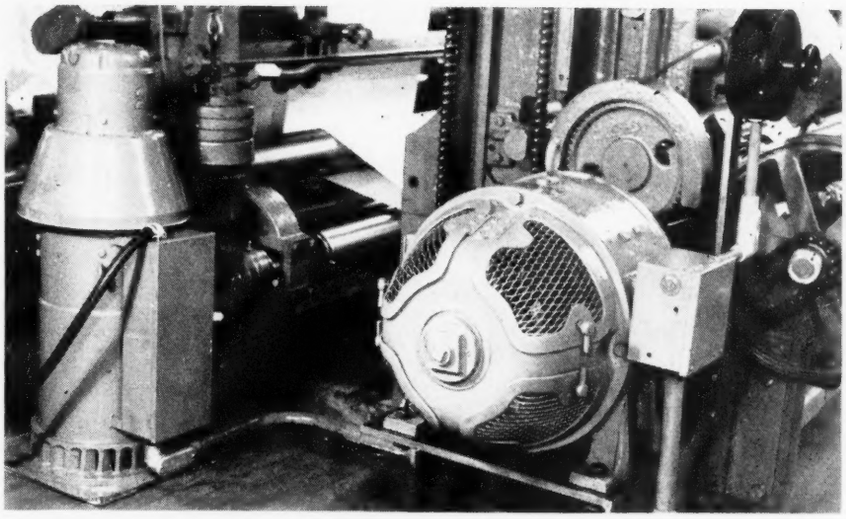


Fig. 1—Vertical variable-voltage motor-generator set on left and direct-current adjustable-speed motor on the right equipped with anti-friction bearings

below 32 F require an oil of low pour point (minus 10 F or lower) and of relatively low viscosity to insure ready distribution when starting. Operating temperatures above 150 F require comparatively viscous oils.

Similar considerations must affect the selection of greases. Low temperatures (below 32 F) require a soft- or medium-consistency grease for quick distribution, whereas at high temperatures (above 150 F) a high-grade soda-base grease of hard consistency (No. 3) that will not "bleed" or separate is required. If an unstable grease is used and bleeding occurs, the free oil may be thrown out, leaving in the bearing only the soap base, which hardens and affords no lubrication to the bearing. Moreover, hardening and drying of some greases are accompanied by an increase in acidity that is likely to cause corrosion. This, however, can be overcome by using a high-grade grease that will not deteriorate in storage and service.

Operating temperatures of ball or roller bearings depend on many factors, the most important being load, speed, construction of housing and support, surrounding air temperature, ventilating, and quantity of lubricant.

The higher the load, speed, and surrounding air temperature, the greater will be the operating temperature. On the other hand, the more massive the housing and support and the better the ventilation, the lower the operating temperature.

Not the least of these factors is the quantity of lubricant packed or fed into the bearing. In fact, after the bearing has been installed, this is the only controllable factor. A too-meagre supply or an oversupply will both cause overheating. Under-lubrication means metal-to-metal contact, resulting in rapid wear, heating and early replacement. Over-lubrication, especially with grease, will cause early replacement of the bearing, because of excessive fluid friction. Such overheating causes expansion and binding of the balls or rollers in the races. This expansion tends to loosen the inner race which permits it to move relative to the shaft. Because the race is made of hard alloy steel and the shaft is generally of soft steel, the shaft wears rapidly, causing misalignment and pounding. Similarly, the outer race may become loose in the housing and cause similar results.

Speed and temperature are related, temperature being in part the result of speed. High speed means that if oil is used it should be of low viscosity and used sparingly to prevent overheating. Likewise, if grease is used it must be of soft consistency and also used sparingly. Experience has proved, however, that an extremely hard grease may be used successfully at extremely high speeds, above 10,000 rpm. In this case the grease channels, and a sufficient amount of oil for lubrication "sweats" from the grease. The grease must be such that it remains quite hard at the operating temperature.

Table II—Guide To Selection of Ball- or Roller-Bearing Greases

Operating conditions		Viscosity of mineral oil, SSU at 100 F	Type of grease	Consistency
Temperature, F	Speed, rpm			
32–150 (Normal)	Up to 2000	400–500	Calcium* or soda	No. 3 (Medium)
"	3000–5000	300–400	Calcium* or soda	No. 2 (Soft)
"	5000–10,000	200–300	Soda*	No. 1 (Very soft)
"	Above 10,000	100–150	Soda*	No. 0 (Semifluid)
150–200 (High)	Up to 2000	500–600	Soda**	No. 4 (Hard)
	2000–5000	400–500	Soda**	No. 3 (Medium)
	5000–10,000	300–400	Soda**	No. 2 (Soft)
	Above 10,000	200–300	Soda**	No. 4 (Hard)

** These greases should contain 12 to 15% soap, remainder mineral oil. Use calcium base in presence of moisture, as soda-base grease emulsifies with water. They should be free from acids, alkalies and fillers. Moisture and ash content should be less than 2%. Greases are not suitable for speeds above 5000 rpm where moisture is present.*

*** These greases should contain 18 to 20% soap, remainder mineral oil. Greases should not be used in the presence of moisture at these temperatures. They should be free of moisture and contain no fillers such as talc, rosin, graphite, mica, etc, and should be of a smooth texture — not of a fibrous or spongy nature.*

Oil for High Speed

In general, oil is preferable for high speeds and grease for low speeds. Whether the dividing line is 1000 or 2000 rpm depends mainly on the method of application and type of closure.

Ball and separator speeds are more reliable indices of lubrication requirements than shaft speed, where two or more different-size bearings are mounted on the same shaft. For example, a small bearing mounted on a shaft operating at 2500 rpm might be splash-lubricated, whereas a larger bearing mounted on the same shaft might, because of higher ball speed, create sufficient friction to

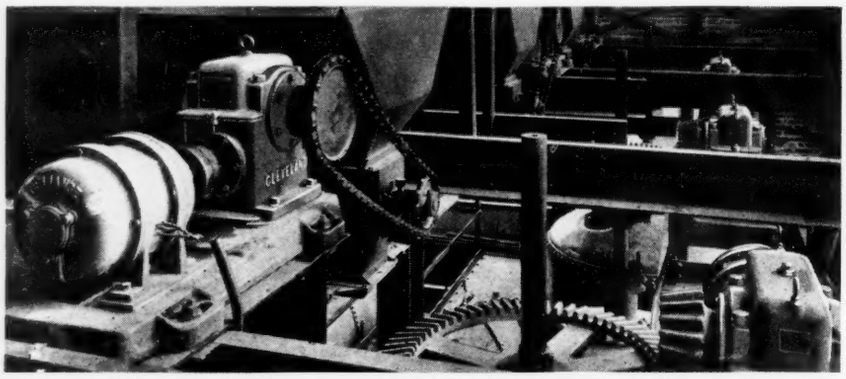


Fig. 2—Three 5-hp and three 10-hp, 1160-rpm, squirrel-cage motors directly coupled to worm gears. All have anti-friction bearings

cause overheating, requiring the use of a different lubricant or method of application, or both.

In a radially loaded ball or roller bearing, the load on any specific ball or roller is not constant but varies from zero to some maximum value, depending on the ball or roller position with respect to the direction of the load on the bearing. The higher the speed, the shorter the time during which any particular ball or roller is subjected to the maximum pressure, and the less likely is oil-film rupture. However, because of the spacing of the balls or rollers, the load is not transferred from one ball or roller to the adjacent one gradually but to a certain extent is applied suddenly, resulting in vibrations and impact- or shock-load conditions. This action is greatly magnified at high speeds and is one of the contributing causes of decreased load-carrying capacity of these bearings.

Bearing Loads

Load considered alone is not a true criterion for selecting lubricants for bearings, but it is necessary to consider jointly load and speed, because of the effect of the load on the speed. Bearing size enters into the problem because of its effect on ball or roller and separator speeds. If the speed of these elements is made the basis of selection rather than the shaft speed, it is not necessary to consider size in choosing the proper lubricant.

Methods of applying lubricants to ball or roller bearings may be divided into two divisions, as follows:

I. Methods of oil application:
- a. Drop feed
  - *1. Sight drop-feed cups*
  - *2. Wick-feed cups and boxes*
- b. Splash
- c. Bath, Fig. 4
- d. Atomization or spraying, Fig. 8
- e. Circulation, Figs. 3 and 5
- f. Ring or collar

II. Methods of grease application:
- a. Grease-packed
- b. Grease gun
- c. Grease cup

In the case of splash, circulation, and ring oiling, the oil used should be of the highest grade, chemically stable, and highly resistant to oxidation and sludging, as it is reused over a considerable period of time.

Where the drop-feed method is used, the oil is used only once and then runs to waste; thus the oil is not required to render long-continued service. A relatively low-grade oil may be used in this case, provided it is non-corrosive and is free of abrasive and other foreign material.

The grease-packed method requires less attention than any other. Frequently, where operating conditions are not severe, ball or roller bearings are grease-packed in assembly and no further attention is required.

When it is necessary to refill bearings, it is usually done with grease cups or gun fittings screwed directly into the housing or connected through piping to a common header located at some convenient position. Where such fittings are used, it is advisable to tap a hole opposite the fitting and, when refilling, add only enough grease to cause the old grease to ooze out at this point. Grease-packed bearings should never be filled more than half-full; generally one-third is sufficient. For greasing methods see POWER, page 110, May 1941.

Splash, bath, and all methods of grease application are restricted in general to relatively low speeds. Drop-feed, wick-feed, and circulation methods are satisfactory for medium speeds, whereas spraying or atomization, wick-feed, and circulation methods are best adapted to high speeds. Tables I and II give the properties of suitable lubricants for various normal operating conditions. Excessive shock-load conditions require special consideration.

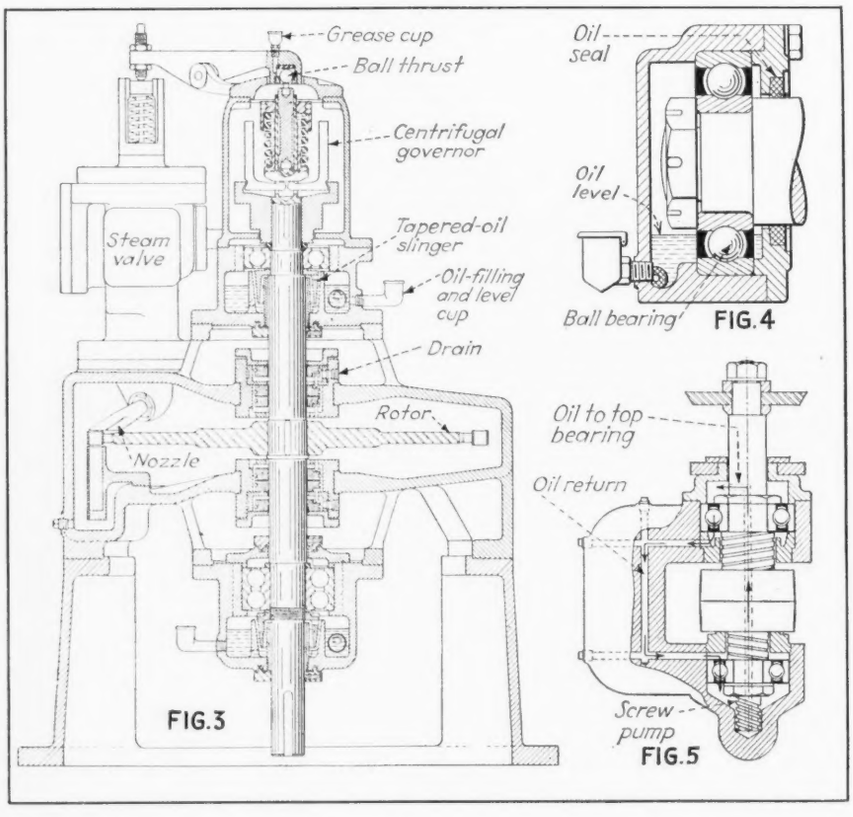


Fig. 3—High-speed vertical steam turbine equipped with ball bearings, lubricated by oil slingers. Fig. 4—Bath oiling applied to a ball bearing. Fig. 5—High-speed spindle equipped with ball bearings lubricated by self-contained circulating system

THE OPERATING ENGINEER

George Edwards
Advisory Editor

Practical Aids
Maintenance Hints
Questions — Answers

Published monthly as an integral part of POWER

Need More Steam from Your Boilers?

Harry Spring tells what limits boiler capacity, points out possible dangers of high-rating operation, and shows what precautions to take to avoid trouble

IT IS LIKELY that there has never been more need for forcing boilers than now. New boilers, that could be obtained in a few weeks or at the worst a few months before the present emergency, may now require anywhere from several months to more than a year for delivery. The field of second-hand boilers has been well culled and with the cream of the crop taken many of those available may not be desirable.

This all adds up to the fact that existing boilers must be nursed along at the greatest practical capacity in many plants. This high-rating operation will be at the expense of efficiency in many cases but cannot be at the expense of safety or continuity of service. Operators faced with the problem of getting more steam out of the "old teakettle" will want to know what limits capacity of various types of boilers, what are the possible danger points and what precautions to take.

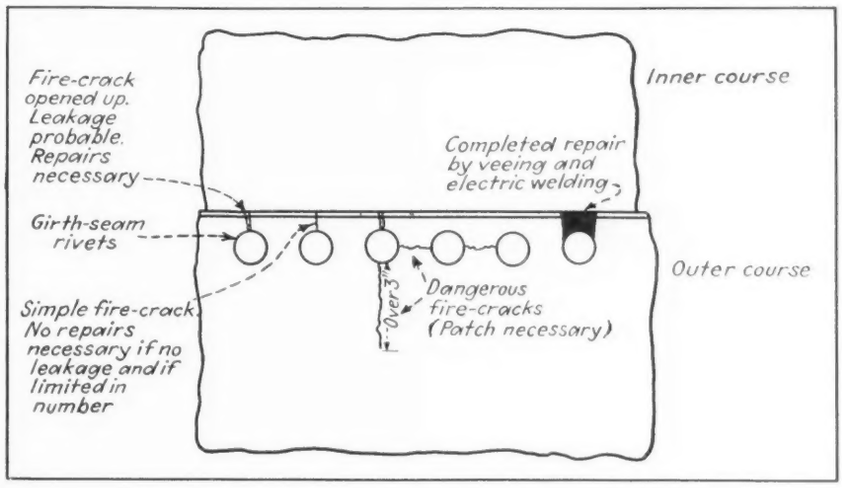

Fire-crack opened up. Leakage probable. Repairs necessary
Girth-seam rivets
Simple fire-crack. No repairs necessary if no leakage and if limited in number
Inner course
Completed repair by veeing and electric welding
Outer course
Dangerous fire-cracks (Patch necessary)

Fig. 1—Various kinds of fire cracks on girth seam of hrt boiler

Fig. 2—Bulge in hrt shell plate caused by overheating resulting from scale

What limits the output of a boiler? In any particular case it may be one of several things. These divide into two parts: (1) those that limit the amount of heat liberated in the furnace, and (2) those that limit heat absorption in the boiler surface.

A detailed discussion of limitations on the fuel-burning rate is not intended in this article, which deals particularly with the effect of high ratings on the boiler itself. However, some of these limitations include: inability of handling or burning equipment to operate at a higher rate, flame impingement or smoking caused by a low setting or a small furnace, clinkering or slagging of tubes, resulting from excessive burning rates, and inability of draft equipment to supply more air or handle larger volume of gas.

Let's look now at the heat-absorption end of the picture. Heat released in the furnace reaches the tubes in two ways. That part of the boiler exposed to the light of the fire receives heat by *radiation*. Other parts of the boiler, not lighted by the fire but swept by the gas of combustion, receive heat by *convection*. That is, heat from gas in transit from furnace to uptake or breeching is transferred to the fire side of boiler heating surfaces.

Depending on the part of the furnace in which it is located, one sq ft of heating surface will absorb a little or a lot of heat. In the "radiant" parts of the furnace, the heat-absorption rate is extremely high. It is generally less in

the "convection" sections, and the rate at any point depends on the temperature of the gas and its velocity. Thus a sq ft of surface in the first bank of tubes absorbs more heat than a sq ft in the economizer and air heater.

Boiler efficiency depends largely on the amount of heating surface in relation to the amount of heat liberated in the furnace. The more surface provided, the more heat that is absorbed from the gas, the lower will be the stack temperature and the higher the efficiency. If the amount of fuel burned in the furnace is increased appreciably, without any increase in boiler surface, there will be a tendency for the stack temperature to rise. Thus boiler efficiency will fall off when boiler ratings are increased much beyond normal.

After heat is transferred to the fire side of tubes or shells, by either radiation or convection, it must flow through the metal to the water or water-steam mixture inside. This takes place by *conduction*, and depends mainly on the temperature difference between the fire side and the inner side. Thus, if boiler tubes stayed clean, this part of the picture would be relatively simple.

Effect of Scale

Soot and slag on exterior surfaces and scale on interior surfaces both affect heat conduction through tubes and shells. Both resist heat flow more than metal and so act as insulators. Heavy deposits on either side of the metal surface will reduce the heat-transfer rate, although not to any great extent. Much more important is the effect of scale on inside surfaces, which may cause overheating. In effect, the scale formation insulates the metal from the cooling action of the water or water-steam mixture and so increases the temperature of the metal. Under normal conditions, overheating caused by scale or oil on the inside of tubes or shell may not be excessive, unless the scale formation or oil film is heavy. However, under high-rating conditions, with higher furnace temperatures and rates of heat absorption, overheating is likely to prove serious. A temperature of 750 F has been considered a safe maximum for the low-carbon steel usually found in tubes and shells. Anything higher invites trouble.

Overheating will also result if the heat which flows into tubes or shells cannot be removed at the proper rate by the water or steam-water mixture inside. How fast heat is removed by the "cooling" fluid depends on the rate at which it flows past surfaces and this depends on circulation. In turn, circulation depends on boiler design, particularly on the size, shape, and length of the tubes forming the steam-water circuit, and on the number and size of unheated downcomers. At high ratings, inadequate circulation may cause some tubes to be "starved" with resultant overheating and possible failure.

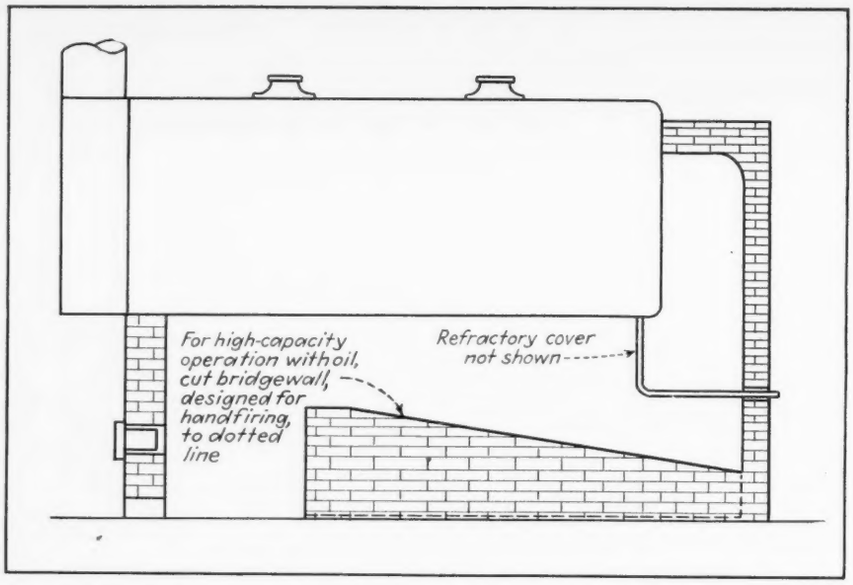

For high-capacity operation with oil, cut bridgewall, designed for hand firing, to dotted line
Refractory cover not shown

Fig. 3—Many hrt's converted from hand to oil firing should have bridgewall modified as shown for high-capacity operation

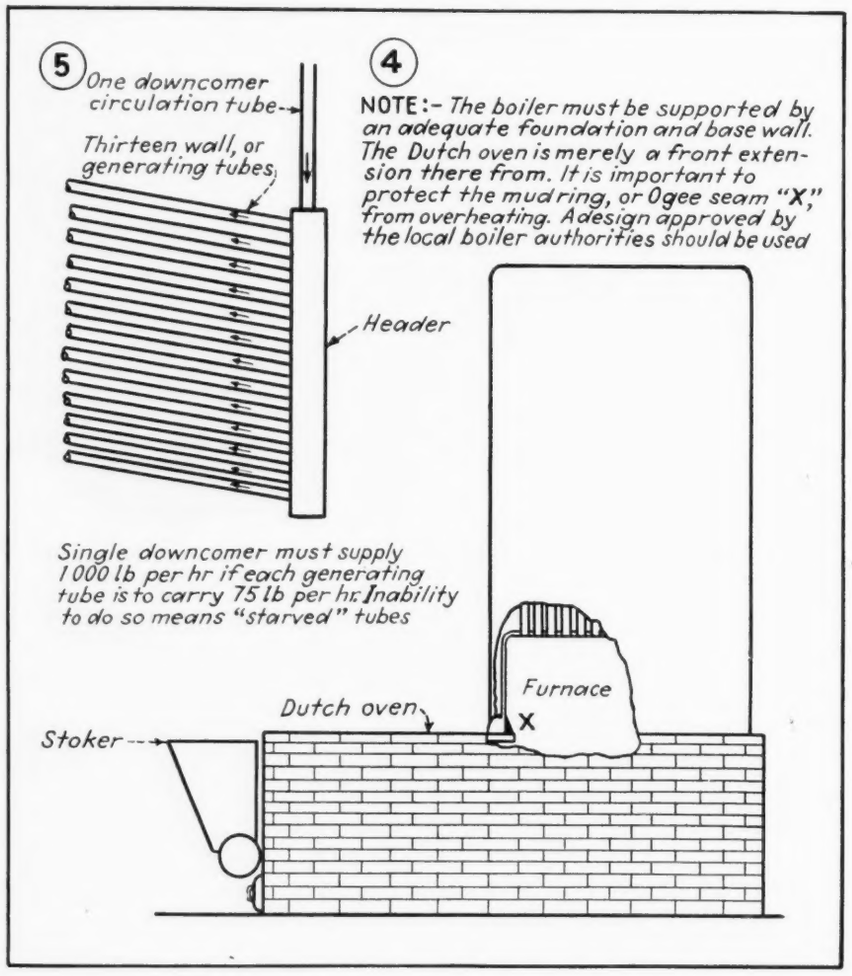

5
One downcomer circulation tube
Thirteen wall, or generating tubes
4
NOTE:- The boiler must be supported by an adequate foundation and base wall. The Dutch oven is merely a front extension there from. It is important to protect the mud ring, or Ogee seam "X," from overheating. A design approved by the local boiler authorities should be used
Header
Single downcomer must supply 1000 lb per hr if each generating tube is to carry 75 lb per hr. Inability to do so means "starved" tubes
Furnace
X
Dutch oven
Stoker

Fig. 4—Adding a Dutch oven increases combustion space in a vertical boiler. Fig. 5—High-capacity operation may cause tube failure in lower row of sectional-header tube bank, if single downcomer can't supply all demands of generating tubes

So much for the general factors involved in high-rating operation. How do these apply to particular boiler types and what precautions must be taken in each case?

The horizontal-return-tubular boiler is probably still the most common

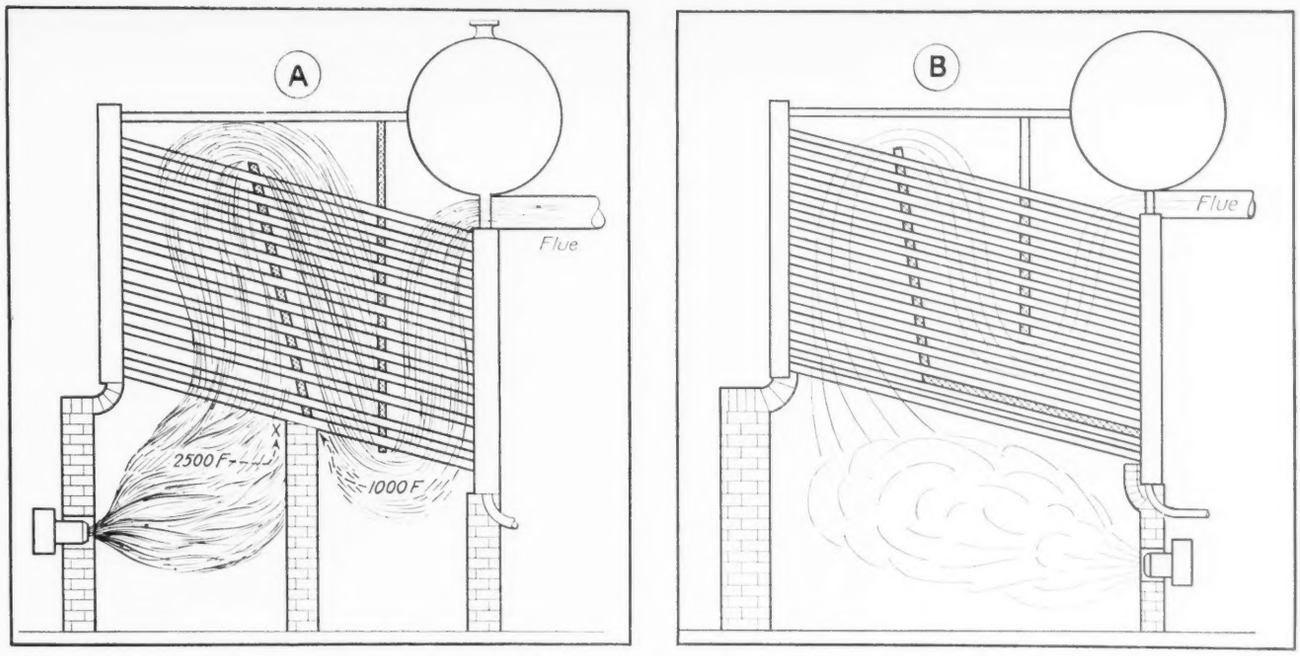


Fig. 6—Firing from rear and changing baffling removed combustion-volume limitation on this cross-drum boiler

in small and medium boiler plants In general, the hrt boiler will *not* stand continuous operation at high ratings without trouble. Disregarding momentary peak loads, the most efficient load for an hrt is usually 75-110% of its rating, based on 34.5 lb of evaporation per 10 sq ft of heating surface, with feedwater at 212 F (this definition of "rating" is used throughout). With emergency loads calling for disregard of efficiency in some cases, the ultimate load that may be carried by an hrt boiler, without inviting shutdown, will depend on two major factors: internal cleanliness and combustion conditions.

With the average hrt boiler, having the internal surfaces coated with a light scale or the usual fine precipitation of sediment, 150% of normal rating is high. Operation at higher ratings invites fire cracking at the girth seam, Fig. 1, and bulging of the shell, Fig. 2. In severe cases, rupture at a bulge may result. Heavy scale calls for reduced rating or, more logically, for a thorough de-scaling job.

Many hrt boilers are set with insufficient combustion space. If the firing rate is increased, flame impingement or localization of heat may occur, and fire cracking or bulging are likely to follow. To increase maximum safe output in cases of this kind, find some way of increasing the combustion space, either by lowering the furnace floor or by raising the boiler. Some old hrt boilers have been converted from hand-firing to oil without proper modification of the bridgewall, Fig. 3. If high rating operation is necessary or if a boiler is to be converted now, the bridgewall should be cut down as shown.

In vertical tubular boilers, combustion space is usually quite limited, automatically setting maximum capacity at a low point. An attempt to exceed safe limits (about 100-140% of rating) will probably result in burned-off beadings at lower tube ends, fire cracking at the furnace seams, and possible burning at upper tube ends. To increase the capacity of vt boilers beyond that possible with the usual internal combustion chamber, add a Dutch oven, Fig. 4.

Water-Tube Boilers

In general, water-tube boilers will carry high ratings successfully; 150% of rating, even for days on end, is quite common and many large modern boilers operate at more than 500% rating. Each case must be judged on its own merits; the best procedure is to increase rating gradually, watching for signs of trouble at danger points.

The principal danger is tube failure, arising, in the main, out of circulation troubles. For example, in sectional-header boilers, loads beyond a certain point may result in the downcomer tubes failing to supply the demand for increased flow to the generating tubes, Fig. 5. In boilers of this type, failures more often occur in the lower rows of tubes and are preceded by bulging. Examination of the fire sides of the tubes should be made during periodical shutdowns. With the eye at tube level and with the aid of a flashlight beam cast along the surfaces, small tube bulges may be detected readily.

Failure of tubes in the upper part of a sectional-header-boiler generating bank is not common but has occurred in some boilers forced at high ratings. The exact cause has been open to discussion but a number of engineers agree that intense heat in some parts of the tube bank causes a circulation disturbance that "starves" tubes in the upper bank.

A circulation disturbance, especially in a waterwall, may follow blowing down a boiler at high ratings. This should never be done except in a high-water emergency. Even then, try to reduce the load first.

Spare tubes should be kept on hand in all cases to avoid possible delay caused by slow delivery of new tubes.

In some cases, it may not be possible to attain the maximum safe output. Two practical measures that may be adopted are: (1) increase the feedwater temperature, either by feed heaters or an economizer, and (2) improve combustion conditions.

If combustion volume is limited, it may be increased by firing the boiler from the rear and changing the baffling, as shown in Fig. 6 *a* and *b*.

In summing up high-capacity operation, it cannot be emphasized too much that the entire plant personnel must "keep on their toes". Emergencies may arise more frequently and are likely to have more serious consequences. The answer lies in more careful plant inspection and maintenance. It is far better to shut down a day or two for inspection than to be shut down for weeks or months by an accident.

Fighting **COAL-BUNKER** *Fires*

Dan Gutleben, chief engineer, Pennsylvania Sugar Co, gives results of ten years experience using CO_2 (gas, liquid and dry ice) to extinguish fires in coal bunkers

FURNACES for our new boilers built in 1931 were designed for high-volatile coal, which has a strong tendency toward spontaneous combustion when in storage. Provisions were therefore made to inject CO_2 into the bottom of the bunkers in case the coal started to heat. About 9 months after we started operation the first smoke was seen in the bunkers, a week after the CO_2 connections were installed. A few bottles of CO_2 gave prompt cooling.

Our log records 12 fires in 10 years. The coal-bunker bottom is not steep enough and a wedge of coal remains dormant on its sides. If this is cleaned out every four months, no heating develops, but if the operators forget the cleaning date, a fire reminds them. After a fire is extinguished, the bunker must be cleaned out of all coked coal that adheres to its bottom or another fire will start about a week later.

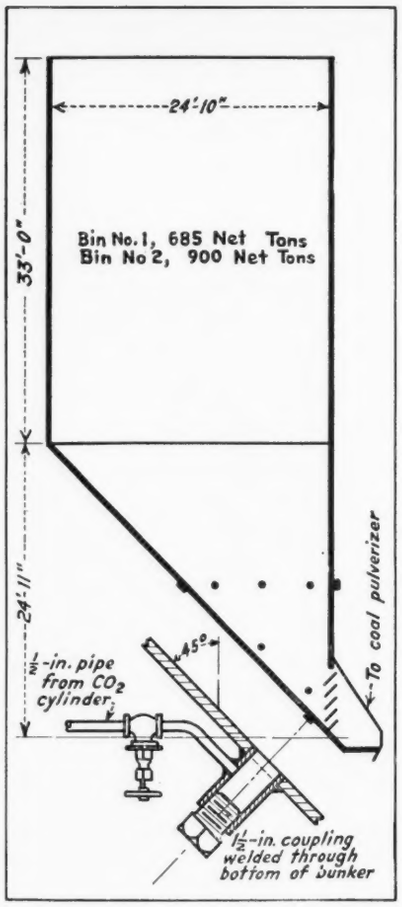
One of our most uncomfortable experiences occurred 2 years after the plant started. As originally installed, the CO_2 system consisted of ¾-in. perforated pipes fastened to the inside of the bunker bottom with an inlet connection through the plate. Heretofore the system had worked perfectly, but on this occasion failed to respond. By the time the coal surface got low enough to admit air through the louvred outlet at the bottom of the hopper, the coal was spouting flame and the plates were beginning to warp. The high temperature was getting close to a column that supports the chimney carrying a 350-ton load. We commandeered 50 bottles of liquid CO_2 from our by-products plant. By blowing this through the louvres while workmen hoed the coal towards the pulverizer hopper, the fire was controlled until the bunker was emptied 4 hr later. An occasional lump of red coke had to be raked aside to prevent it from going into the pulverizer. When the bunker had been cleared out it was found that the holes in the perforated pipe had rusted shut so that the CO_2 could not be discharged at the fire. These pipes were then removed and replaced with inlets of a design shown in the drawing, which have served effectively. On eight occasions in the last seven years they have overcome the results of operating forgetfulness!

Recently we encountered a new experience. A strike shut down the three Philadelphia refineries. In the 10th week of idleness, No. 1 bunker got hot near the bottom of the outlet hopper and smoke started coming out of the top of the bunker. Liquid CO_2 promptly stopped the smoking and the bin cooled. While the operator was patting himself on the back for the good job he had done, No. 2 bunker suddenly sent up a cloud of smoke. This time, however, heating extended all along the front of the bunker, over the outlet and the full depth of the coal. Presumably this was the path of the air movement through the coal.

Immediately a ton of dry ice was ordered, but as our plant was not operating, there was delay in the delivery. By the time the ice was delivered smoke above the bin had reduced the visibility to zero. By that time there was a glowing spot on the surface of the 600 tons of coal in the bunker about 3 ft from the front wall just above the pulverizer outlet.

When the blocks of dry ice hit this spot there was a spattering of fire sparks. A half hour later the boys could remove their oxygen helmets and two hours later the smoke had completely subsided.

The gaseous CO_2 filtered down through the coal and flowed out through the bottom outlet. The first dose of dry ice was one long ton. About once a day an additional 55-lb cake was added whenever a tendency to resume smoking exhibited itself. By this means the fire was restrained until the plant resumed operation and the coal was sent into the boiler furnace two weeks later. For those interested in the use of CO_2 for fire fighting the following data is submitted:



Cross-section through coal bunkers and CO_2 connections to them

VOLUME OF CO_2 GAS AT ATMOSPHERIC PRESSURE

Temperature deg F	*Cu ft of gas per lb*	*Wt per 100 cu ft of CO_2 gas, lb*
−109	5.66	17.6
+32	8.2	12.3
+50	8.5	11.8
+60	8.6	11.6
+70	8.8	11.4
+80	9.0	11.2
+90	9.1	11.0
+100	9.3	10.8

A 50-lb bottle of liquid CO_2 requires 20 min to discharge when the outlet is on top so as to discharge gas. If the bottle is turned up-end-down, the discharge is in liquid form and the time required is 3 min or less. Pressure in the bottle at 70 F is about 838 lb per sq in. gage and one cubic foot of this liquid weighs 47.35 lb. CO_2 gas is 1.5197 times as heavy as air.

One standard 10-in. cube of dry ice weighs about 55 lb and its weight per cubic foot is 95.0 lb. One pound of CO_2 at its solidifying temperature of 109.3 F below zero equals 5.66 cu ft of gas at atmospheric pressure. At 70 F the gas volume expands to 8.8 cu ft per pound, as shown in the table. A 50-lb. bottle will therefore fill 50÷8.8= 440 cu ft of space with gas at atmospheric pressure. Dry ice begins to change into a gas when the surrounding temperature rises above 109 F below zero and at atmospheric pressure.

The Strange Case of the
LEAKY NOZZLE FLANGES

John Gorrie, boiler inspector, passes along the tale of the caulking ridge, the twisted rivets and the unreamed rivet holes

FOR A NUMBER OF YEARS the chief engineer of a certain power plant was bothered by a persistent "sputtering and bubbling" leakage of steam from the steam-nozzle flanges of his four 5000-sq-ft watertube boilers. On each boiler there were two drums, with a nozzle on each. All the nozzles were riveted to their respective drums.

The leakage had the peculiar habit of coming and going, and sometimes the leaks were worse than others. Again there were the lay-off times, when "Jock Steam" didn't want to escape. Caulking was attempted on several occasions, without results, then it was decided to seal-weld the flange seams to the drum-shell plates. But the trouble was, if they were welded, would the welds hold?

It was then decided to remove the steam nozzles from their drums. The rivet heads were burned off, and the rivet shanks driven through, an aggravating job. The nozzle was removed (the first one) and the flange turned over to see its condition. The chief cussed and the boiler inspector foamed at the mouth, and no wonder, for there before all eyes was a bonny sight.

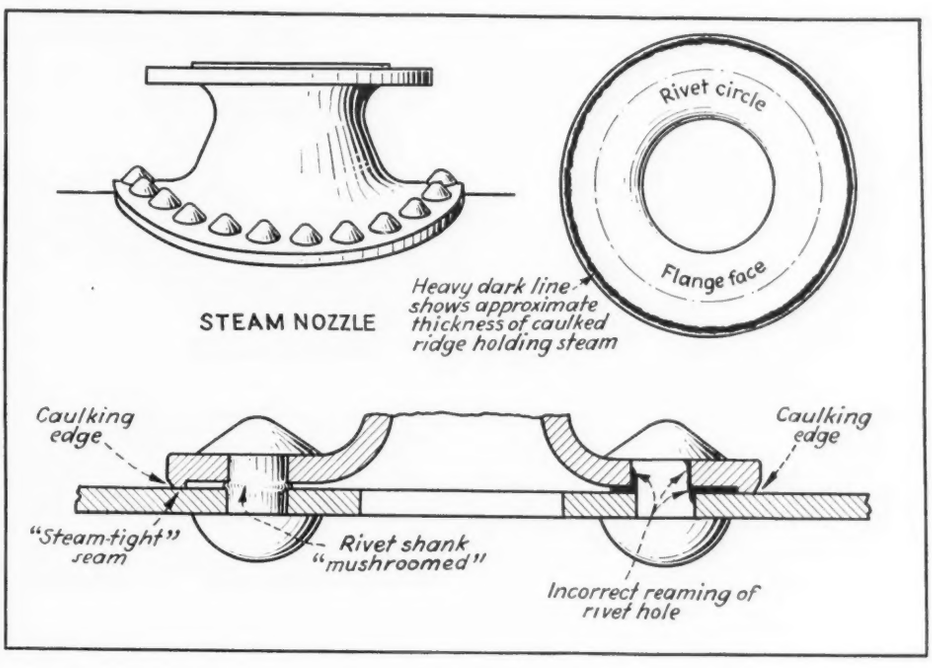
The flange had been excessively caulked and not only that, the flange at no point had ever come into intimate contact with the drum-shell plate. The flange showed evidence of being steam swept over its whole area, and it was the caulking "ridge" that kept the steam imprisoned. There was a ridge ¼-in. high and the same dimensions wide. At one point the depth of the ridge was approximately 3/32-in.

A scramble was made inside the drum to retrieve the driven rivets, and, naturally, there was more cussing. The rivet shanks were of various twists and contortions. There was also evidence of the shanks having never even fitted tightly in the rivet holes. Approximately half of the rivet shanks had been mushroomed between the flange and the shell plate. The rivet holes were then looked at. Some had been reamed, and some had not, and some showed a peculiar "houkin' or delvin'" as if an Aberdeen granite quarryman had been testing his reamers.

The outcome was that all the flanges were removed from all the drums, and the same conditions were noted on all the flanges. Naturally there was a variation in depth of the caulking ridge. The rivets, and their holes, were in the same condition as those first examined.

To eliminate the trouble, the so-called caulking ridge was chipped off, and the flange surfaces ground down. The drum-shell plates were treated to a surface polishing with the portable hand grinder. The nozzles were then bolted down tight, with red lead to show the "high spots," which received a little more grinding. Feelers were tried, and at the first reading, there was only one spot, roughly two inches along the outside of the flange, which admitted a .010-in. feeler, the flange having been bolted down with six bolts.

It is admitted that a little "padding" had to be done with a lead hammer, and it was worth the effort. There was a satisfaction in knowing that the flanges would not give any more trouble, as at the hydrostatic test pressure of 250 lb, there was only a "wee weep."



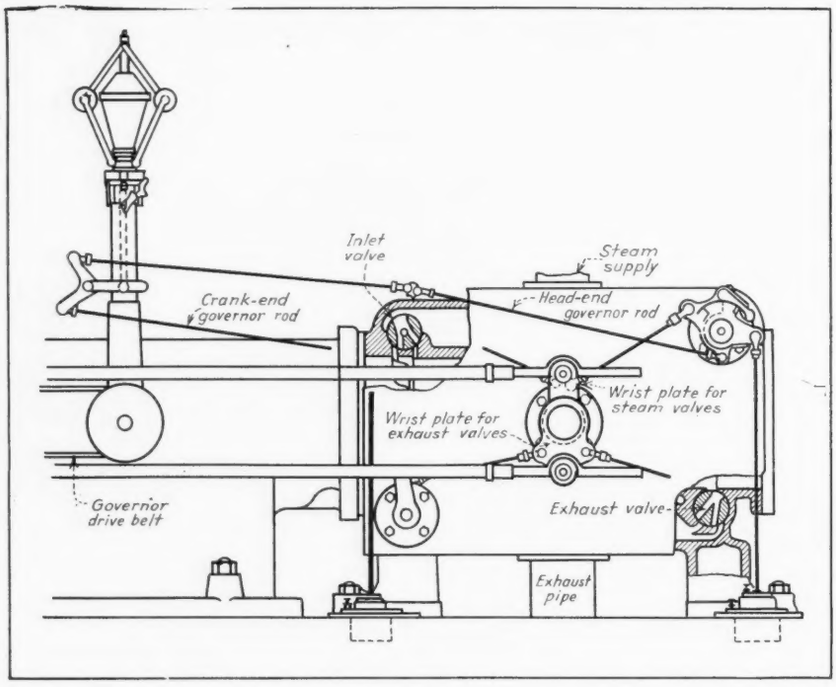
READERS' PROBLEMS

Questions from Our Readers

Engine Will Not Release

Question 1

WE HAVE A 14x30x42-IN., 98-RPM, *170-lb, Hewes & Phillips cross-compound double-eccentric engine which at times carries a load of 640 hp. When setting the valves on this engine the cutoff must be set shorter on the crank end than on the head end, or the crank end will not release during heavy loads. What is the reason for this and what can be done to correct it?*—WHS



What Causes Excessive Brush Wear?

Question 2

WE HAVE A 5-HP, 230-V, 3400-RPM DC MOTOR *driving a centrifugal pump which delivers water against a 60-lb head with a 20-lb suction pressure. This motor has four brush-holder arms. We find it impossible to secure a reasonable life from the brushes on two of the arms, located opposite each other. The brush life on these two arms is less than half the life of the remaining brushes. Can* POWER *readers offer any suggestions to remedy this?*—SHP

SUITABLE answers from readers will be paid for if space is available for publication. Answers accompanied by practical drawings or photographs will command additional pay.

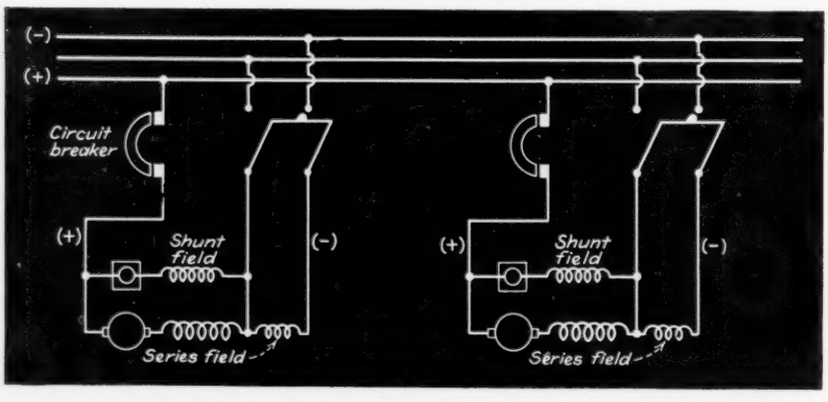
How Did It Happen?

Answers to Nov Question 1

The Question

TWO COMPOUND-WOUND EXCITERS *were connected for normal operation in parallel. There was the usual neutral connection and the field and neutral leads of each machine went to the same double-pole switch. The remaining armature lead connected to a single-pole switch, as shown in the sketch. With the leads arranged in this manner, operating practice required that the double-pole switch always be closed first when paralleling. These machines operated satisfactorily both before and after the following incident.*

One evening the operator in paralleling the exciters caused a reversal of polarity in both of them, yet they remained in parallel and carried the evening load with no inconvenience except that the ammeters and voltmeters did not register. It was necessary to flash the fields in the reverse direction to bring the machines back to normal. Can POWER *readers explain the sequence of events that caused this condition?*—EWF



Motor May Add to Complications

EWF DOES NOT GIVE ANY INFORMATION about the source of power for the exciters. Assuming that one exciter is motor and the other engine driven, if the engine-driven exciter was paralleled with a voltage lower than that of the motor-driven exciter, it would become motorized and throw additional load on the motor-driven unit. This would cause the ac voltage to drop enough to reduce the driving power from the motor and allow its generator to motorize in turn from the engine-driven exciter. Since the residual magnetism of the engine-driven exciter was reversed during the time it was motoring, its voltage would build up with reverse polarity and in turn motorize the other exciter. About that time the operator adjusted the shunt-field rheostats to the point at which, from previous experience, he

knew the generators should operate in parallel. The motor-driven exciter then came back as a generator with the same polarity as the engine-driven unit, which had been reversed from its original.

I suggest that EWF refer to the Aug 10, 1940 issue of *Electrical World*, page 76, "Reverse-Power Relay Changes Exciters."

Duluth, Minn. G I SMITH

Voltages Not Equal

ONE CHARACTERISTIC of a compound-wound machine is its ability to respond quickly to variations in voltage which are normally caused by load changes. Evidently the operator, in attempting to parallel the two machines, closed the switches with either a lower or higher voltage on the incoming machine than was being carried on the unit in service. Whichever condition prevailed caused an abnormal current flow between the fields of the two machines. This reversed the polarity of the weaker unit, which momentarily dropped its load entirely. When this machine again built itself up (with a reversed polarity) it regained an abnormal voltage so quickly that it took the load away from the loaded machine. This in turn caused another unusual exchange of current between the field windings of the two generators, of enough magnitude to reverse the polarity of the second machine. This interchange and reversal takes place in a split second of time.

Duluth, Minn. E R WEBBER

Reversed Residual

THE SOLUTION TO THIS PROBLEM seems to be a case of analyzing the events and possibilities. Assuming that the bus was dead before the first unit was put on, the operator, being thoroughly familiar with the equipment, started up No. 1 unit in the usual manner. The voltmeter showed no reading so he moved the rheostat a little more than usual and still getting no reading, he believed the voltmeter to be out of order and put the unit in service without further trouble.

Starting the other unit he brought it up to the usual speed and voltage and cut it in on the bus. Immediately there was a flash back and the polarity of No. 2 machine was reversed to suit No. 1, as explained in the following sequence of events. No. 1 machine had a reversed residual magnetism in the field and in starting it built up in the reverse direction. Thus no voltage was shown on the voltmeter even when the rheostat was moved beyond its usual setting. This allowed a higher voltage than usual, but with the wrong polarity.

No. 2 machine was started in the usual way and, carrying the normal voltage, was paralleled on the bus. The higher voltage from the machine with the reversed polarity simply reversed the polarity of the incoming machine, but both remained in parallel and operated satisfactorily. It is possible for this to happen at any time unless the voltage and polarity of each unit is correct before it is put in service.

Kearny, N. J. GEORGE MCNALLY

Condition Not Unusual

IN EWF'S PROBLEM we will assume that the exciters are of same design, compounded alike and connected properly. The sequence described by EWF is not alarming and takes place quite frequently. Often the instantaneous rush of current becomes so great that its effect in flowing through the series winding is to reverse the direction of the magnetic field, building up its voltage in the reverse direction. Initial decrease would cause a diminution of excitation which would further reduce the current, affecting the field strength. Such action will continue until exciter B carries the entire load, and exciter A carries none, and proceeds until exciter A is running as a motor driven from exciter B, that is, exciter A is taking current from the bus instead of delivering current to it.

Schenectady, N. Y. CARL BACHMANN

Speed Improperly Controlled

I BELIEVE THAT THE REVERSAL of polarity in EWF's problem can be explained in the following way.

The operator may have paralleled the exciters successfully and then discovered that the speed of both prime movers for the exciters was too high. He then reduced the speed of one, causing it to act as a motor with a current flow reversal. Thus the first exciter was reversed. Then he suddenly slowed the speed of the second exciter, causing it to act as a motor, and thus get its polarity reversed.

Schenectady, N. Y. L W RIGGS

Finding Engine Speed

Answers to Nov Question 2

The Question

SOME OF OUR YOUNG ENGINEERS SAY *that examiners are asking the following question: "Assume a shaft-governed steam engine without a nameplate on engine or generator. The engine is idle and must not be started to permit use of a speed indicator. How can the engine speed be found?" I wonder if* POWER *readers have any ideas on the solution of this problem which looks like a trick question, with only one simple answer?*—WHF

Check Valve Position

REFERRING TO THE QUESTION of finding the normal speed of an engine-generator unit with all nameplates removed, WHF should first remove the cover on the governor-controlled steam valve. He should then block the governor flyweight out so that the valve is held nearly all the way closed. Quite a large error in estimating the full-load position of the valve will introduce no great error in the calculated speed, as the governor "regulation," or speed difference between no load and full load, is usually only about 10%. Hence the error should only be about 2% at most.

Next, using a spring scale or some other means of directly measuring force, he should pull out *radially* on the governor flyweight until the block just falls out. This will give him the force the flyweight exerts at that position of the valve. The flyweight should then be removed and weighed, or at least measured and the weight calculated. A simple equation can now be set up, equating the centrifugal force to the product of the mass, the radius on which it rotates, the speed (unknown) squared, and a constant depending on the units employed.

Rockford, Ill. URBAN FLOOR

Action of Centrifugal Force on Flywheel

I BELIEVE THE ANSWER TO WHF's problem lies in finding out the maximum number of revolutions allowable for the flywheel on the engine. A flywheel must be operated at a safe speed because the centrifugal force tends to tear the rim asunder. The cohesion of the material of which the wheel is composed resists this tendency. The centrifugal force increases as the square of the number of revolutions increases. From this it can be seen that an ap-

parently slight increase in the number of revolutions per minute may be sufficient to burst the wheel. For solid cast-iron wheels and for built-up wheels of cast iron where the strength of the joint is equal to the strength of the rim, the greatest number of revolutions per minute that would be safe, may be found by the following simple rule: *divide 1930 by the diameter of the flywheel.* Thus, if a flywheel is 20 ft in diameter, a safe speed would be 1930 ÷ 20 = 96.5 rpm.

Jackson Heights, N. Y. F DANIELS

Not a Trick Question

THIS IS NOT A TRICK QUESTION, as WHF seems to think. The engine speed can be determined from the governor dimensions with the aid of the formula expressing the relation between governor weights and the speed of the engine. The formula is this:

$V^2W = Cgr$, in which

V = the tangential velocity of the weights in fps

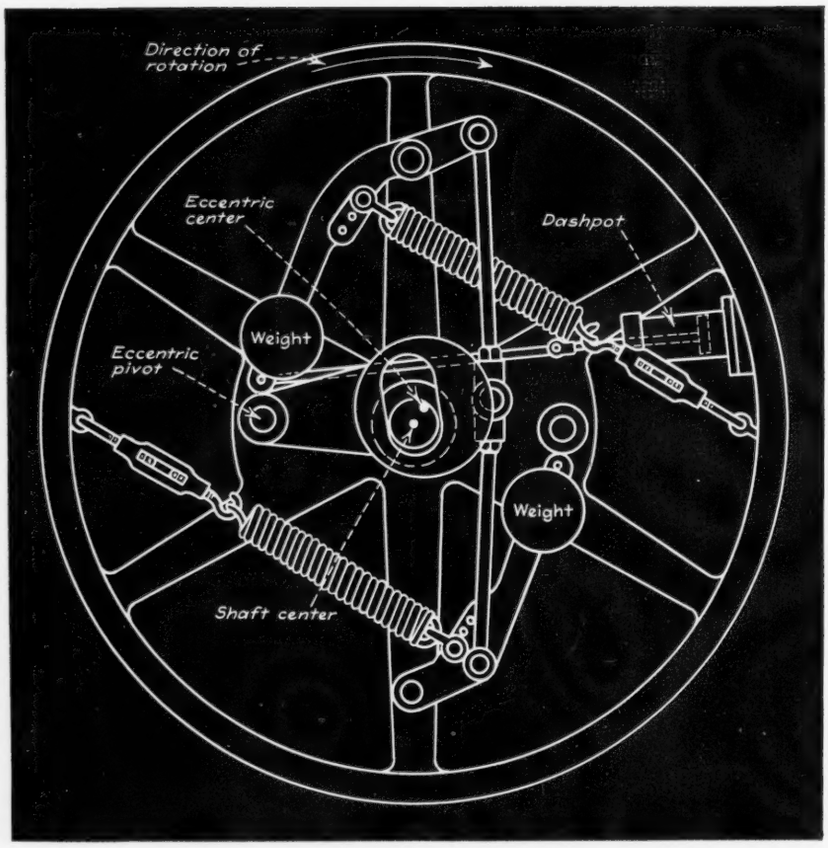
W = the weights, in lb

C = the total centrifugal force, in lb

g = the acceleration due to gravity = 32 ft per sec per sec

r = the radius of rotation of the weights, in ft

In solving this formula, V is the unknown, as all others can be determined by measurement. W can either be estimated from the size of the weights or they can be removed and weighed. In order to determine C, the weights will have to be pulled out to their operating position and the force to hold them there measured. To do this a power hoist may be required. r is the distance from the center of the shaft to the weight, when in full-speed running position.



Position of the governor weights for maximum valve travel is shown in the attached sketch and with the engine placed just past dead center the valves will be wide open. Pulling the weights out until the valves are almost closed will show their position for normal no-load speed. This position will give slightly more than minimum valve travel. The force necessary to hold the weights in this position is a measure of the centrifugal force acting on the weights at normal speed. This pulling force must be exerted in a radial line from the center of the shaft, in line with the weights.

If we assume $W = 100$ lb, $C = 1000$ lb, and $r = 1$ ft, substituting in the formula we have,

$$V = \sqrt{(1000 \times 32 \times 1)/100} = 18 \text{ fps or } 175 \text{ rpm}$$

Chicago, Ill. N T PEF

Rim Speed and Frequency

IF GENERATOR STATED IN WHF's question is an alternating-current machine the following method may be used to determine engine speed: (1) Find the frequency of the power generated. This may be found by inspection of nameplate on some motor that draws energy from generator when in operation. (2) Count the number of poles on the generator field winding. With these two values inserted in the equation below the rpm may be determined

$$\text{rpm} = \frac{120 \times \text{frequency in cycles per second}}{\text{number of poles}}$$

Another method for speed determination which is not as exact as the above but may be used as a guide in case the generator is not an alternator is as follows: (1) Select a value of permissible rim speed for flywheel. Values of allowable rim speeds depending upon type, size, service, etc, may be found in standard design texts, handbooks, etc. (2) Measure flywheel circumference, then

$$\text{rpm} = \frac{\text{selected value of rim speed in fpm}}{\text{circumference of flywheel in ft}}$$

Baton Rouge, La. G F MATTHES

Says It Is a Trick Question

WHF IS CORRECT in assuming that this is a trick question asked by examiners. It is intended primarily to test the engineering applicant's sense of cautiousness and ability to realize the hazards involved when starting up a steam engine. However, no examination can be considered thorough without questions of this type, which in diverging from accepted power-plant practice and general engineering theory, serve to test the young operating engineer's aptitude for his chosen work.

In answering the question which WHF mentions, it should be stated that it would be practically impossible to determine the engine speed under such conditions. In fact, we are safe in stating that there is no mathematical method to solve this problem in the field. The shaft governors are accurately set and tested at the factory for the designed speed of the engine, and this speed, within close variations, is maintained by the specific governor as long as the equipment is kept in good condition. The examiner should be further

informed that under such conditions one should be extremely cautious in starting up the engine, bearing in mind the fact that its safe operating speed is limited by the maximum safe rim speed of the flywheel in fpm. The rim speed of a flywheel should not exceed 6000. After having taken the proper flywheel dimensions, the safe speed of the flywheel should be determined.

With the load preferably disconnected from the engine, station a helper with an accurate tachometer at the main-shaft extension, and proceed to bring the engine up to speed very slowly. This operation should be carried out cautiously until the governor comes into action, at all times making certain that the safe flywheel speed is not exceeded. If the governor comes into operation before the attainment of the maximum safe flywheel speed, the governor is considered adequate, and the speed as recorded by the tachometer is the operating speed of the engine. This would be the only practical method of checking the engine speed, all other information lacking. The fact that the examiner stated in the question that the engine must not be started up for the check, leads to the one and only conclusion "a trick question to be answered carefully."

Cleveland, Ohio A R CIOTTI

Don't Burst the Flywheel

THE EXAMINATION QUESTION referred to WHF is not as much a "trick question" as would appear on the surface, as it is undoubtedly designed to test the applicant's practical knowledge.

The speed of a steam engine is determined by the safe speed of the flywheel; in other words, the engine speed must remain under the bursting point of the flywheel. If I were confronted with the problem of starting a steam engine whose speed was not known, I would apply the formula which determines the safe speed of the flywheel, which is: 1910÷diameter of wheel, in ft. For example, if the engine in question had a flywheel 10 ft in diameter, 1910÷10=191. Therefore the engine could be safely operated at 191 rpm. The safe speed could also be computed by figuring the rim speed of the wheel, which should not exceed 6000 fpm.

Redwood Falls, Minn. F B MAES

Count the Poles

THE FOLLOWING may answer WHF's question. If the generator be of the salient-pole type, which is usually the case in low speed generators, this formula applies:

$$\text{rpm} = \frac{f \times 60}{N}$$

where f=frequency, N=number of pairs of poles, and 60 = constant. For example, if there are sixteen pairs of poles and the frequency is 60 cycles then the rpm is equal to:

$$\frac{60 \times 60}{16} = 225$$

The same formula is used for turbine-generators which, generally being high speed, have two-pole rotors. The engine will have the same speed as the generator unless there are reduction gears, in which case the gear ratio must be considered.

International Falls, Minn. L A PARKER

Rim Velocity, Piston Speed and Frequency

To avoid natural duplication, we have not printed all of the answers that were received which attempted to solve the problem from the angle of rim velocity, piston speed, or frequency. Using the known frequency and number of poles of an alternating-current generator is a simple and accurate method except for the fact that the type of generator was not stated in the problem.

Use of allowable safe rim velocity is open to question because it does not necessarily follow that engines are operated at their upper speed limits. As piston speeds vary over a wide range this method cannot be depended upon to give reasonably accurate results. Likewise, it would seem that determining speed by governor measurements and calculations is subject to many practical difficulties, although it may have been the purpose of the question to test the applicant's knowledge.

The answers submitted illustrate definitely the value of attacking a problem from all possible angles as well as the importance of following all possible leads to their end before discarding any of them as useless. We wish to acknowledge answers which were submitted by the following readers: J F Maher, Shiprock, New Mexico; L W Riggs, Schenectady, N. Y.; C R Dreber, Wellsville, N. J.; M N Gozdenovich, Fairview, N. J.; C Hackem, Detroit, Mich.; W T Mullen, Philadelphia, Pa.; Frank Haworth, Cambridge, Mass.; H A Kaiser, Glendale, L. I.; Anthony Greer, New York, N. Y.; Leonard Muehlberger, Buffalo, N. Y.; and C G Clark, St. John, N. B.

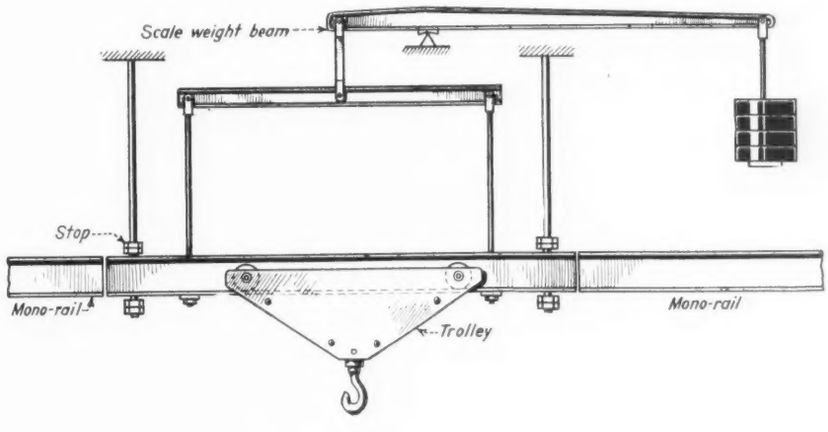
THE EDITORS

Overhead Trolley Scale Solves Weighing Problem

WEIGHING MATERIAL USED IN PROCESS is frequently quite a problem if unnecessary handling and duplication of equipment are to be avoided. In our plant we had to find a convenient and simple method of weighing loads of a dry chemical carried on a monorail system in buckets suspended from a traveling motor-driven hoist.

Numerous methods were discarded as being prohibitively expensive or impractical. Finally we decided to suspend a section of the monorail track from the weigh beam of a conveniently located scale. As shown in the diagram, the track section is suspended in such a way that its total vertical movement is held small to avoid too much difference in elevation at the points where the monorail is cut and cause unnecessary movement of the scale beam.

Roanoke, Va. S H COLEMAN



PRACTICAL AIDS TO OPERATION

Braces Relieve Stresses in Welded Joints

STIFFNESS INHERENT IN PIPE BENDS tends to break the joints where they connect into a manifold, unless safeguards are incorporated in the design to transfer the stresses from the joint into the sweeping curves of the pipe. On one system handling gas at 3,000 lb per sq in., heavy webs were welded on at the joints, as at *A* in the photo. Such braces relieve the weld joints of all stresses save those for which they are designed, insuring pressure-tight connections.

To prevent cramping of the weld with the braces, they are relieved at the angle so as to leave a slight clearance over the bead of the weld connecting the two pipes together. This provides for inspection and rebuilding of the junction weld without interference from the braces, and avoids possible overheating or disturbing the joint weld while placing the braces.

By setting braces at 90-deg intervals around the pipe, two in the plane of probable expansion changes and two at right angles, all vibration which might be set up in the formed bend is eliminated before being able to reach and possibly crystallize the joint weld. Attention is also called to the joint bracing at *B* and *C*.

Houston, Texas CHARLES C LYNDE

Provide Escape Pipes On Safety Valves

ESCAPE PIPES ARE USUALLY considered a necessity on boiler safety valves since they divert the live steam released to where it will not endanger personnel, equipment or the building structure. It is unfortunate that in many plants other safety and relief valves are not similarly equipped.

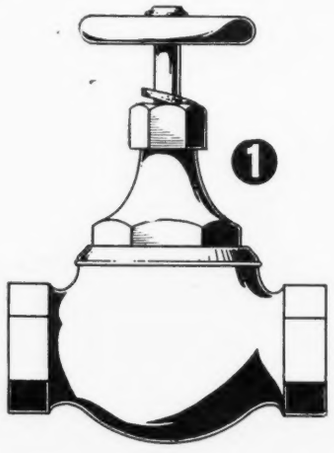
For instance, in one large plant no escape pipes were provided on the safety valves of the steam drums of two large closed-type feedwater heaters operating at 20 and 75 lb respectively. During a period of operating trouble these valves opened, nearly scalding an operator and filling the room with steam. This occurrence not only seriously hampered prompt restoration of service but also made necessary a new paint job on surrounding equipment and building walls.

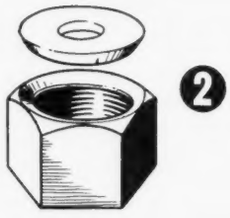
In another case, I was walking past a large air compressor when the safety valves in the discharge line popped. Other than a blinding slug of water and oil in the face no ill experience resulted. Had the safety valves opened due to an explosion in the piping, flame might have struck me; I shudder now to think of what the possible consequences might have been.

Richmond, Va. C R ANDERSON

Quick Repair for Valve-Packing Nut

THE SHUTOFF VALVE ON OUR STEAM WHISTLE is on top of the boilers out of the way and does not get the attention





that it should. This valve leaked around the stem and needed packing. Instead of doing so the fireman tried to stop the leak by tightening down on the old packing, when suddenly the top of the nut cracked out, Fig. 1. This required a quick repair, so I made a steel disk and beveled its edge to fit into a similar bevel in the top of the nut, Fig. 2. Then I brazed the disk into place with low-

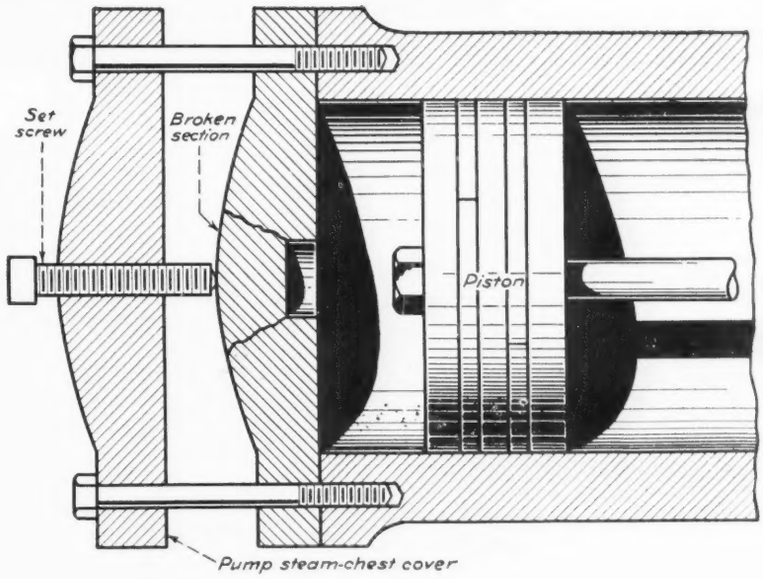
temperature brazing wire and put the nut back into place, the job taking less than one hour to complete.

Englewood, N. J. R BOETTINGER

Emergency Repair for Steam Engine

WHEN YOU HAVE TO PUT A POWER UNIT back into service quickly a little resourcefulness is worth a machine shop and foundry combined. This proved to be the case when the nut backed off the high-pressure piston rod of our tandem-compound engine and knocked a 3-in. hole in the center of the cylinder head. A peak load would be coming on in a few hours and we just had to get that engine going again. We looked around for something from which to make a strong back to hold the broken part in place, but could find nothing.

One of our steam pumps was out of service and we found that two of the steam-chest-cover holes were the same distance apart as the holes in the engine cylinder head. So, we removed the steam-chest cover, after which we bored and tapped a hole in its center for a ¾-in. tap bolt. We removed two of the studs from the cylinder head and put the pump steam-chest cover into place with two long bolts, see figure.

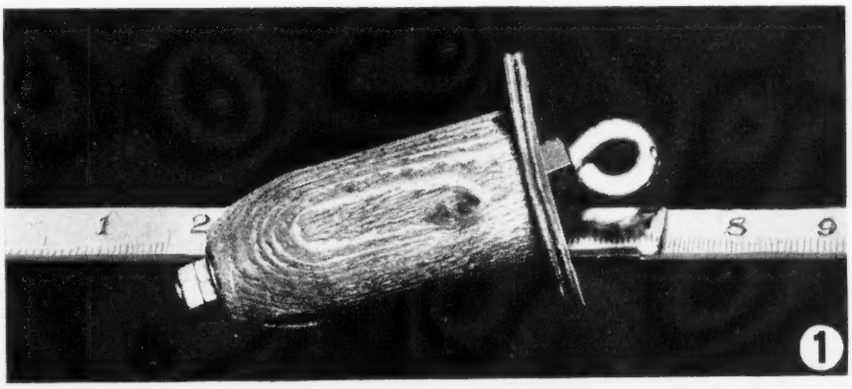


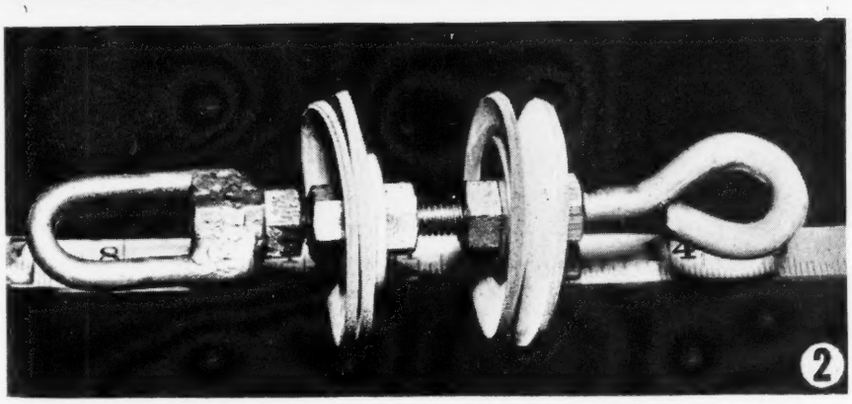
A little quick-drying iron cement was then spread on the fracture of the piece broken from the cylinder head and it was put into place. We tightened the set screw against this piece to put the load on the two bolts supporting the pump steam-chest head. Shortly after this the engine was put back into service and was operated for several weeks until we got a new cylinder head.

Bronx, N. Y. ANTHONY GREER

Mechanical Mole Goes Through Long Conduit

WHEN A DEFECTIVE MULTI-CONDUCTOR control cable was removed from a 2.5-in. conduit, 720 ft long, the pulling crew neglected to attach a cord to the cable to be pulled into the conduit as the cable was pulled out. We had then to devise some means of getting a line through the conduit with which to pull in the new cable. Due to the length of the conduit steel fish tape buckled before it could be pushed all the way through. Small parachutes and ping-pong balls failed to go through by air pressure, because of the cable grease in the conduit.





After these devices failed we made the mechanical mole, Fig. 1. This mole consists of a wooden section about 1.5 in. thick and 4 in. long, tapered at one end. Two 1/16-in. rubber disks slightly larger than the inside diameter of the conduit assembled with the wooden section on an eye-bolt completed the job. A cord was attached to the eye and the mole pushed in the conduit. When air pressure was applied back of the mole it went through the conduit about as fast as the cord could unwind off the ball, or in about one minute.

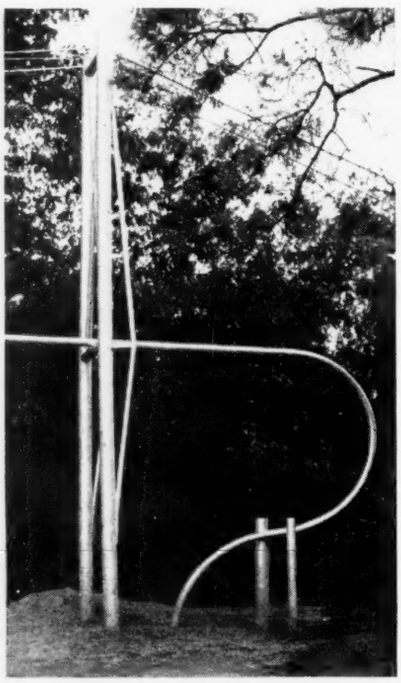
We then made the cleaning device, Fig. 2. This consists of four rubber disks similar to those used on the mole assembled as shown on an eye-bolt, with a second eye on the threaded end of the bolt. This was connected be-

tween two pulling cables and pulled back and forth through the conduit until all grease was cleaned out.

Conestoga, Pa. G L Hess

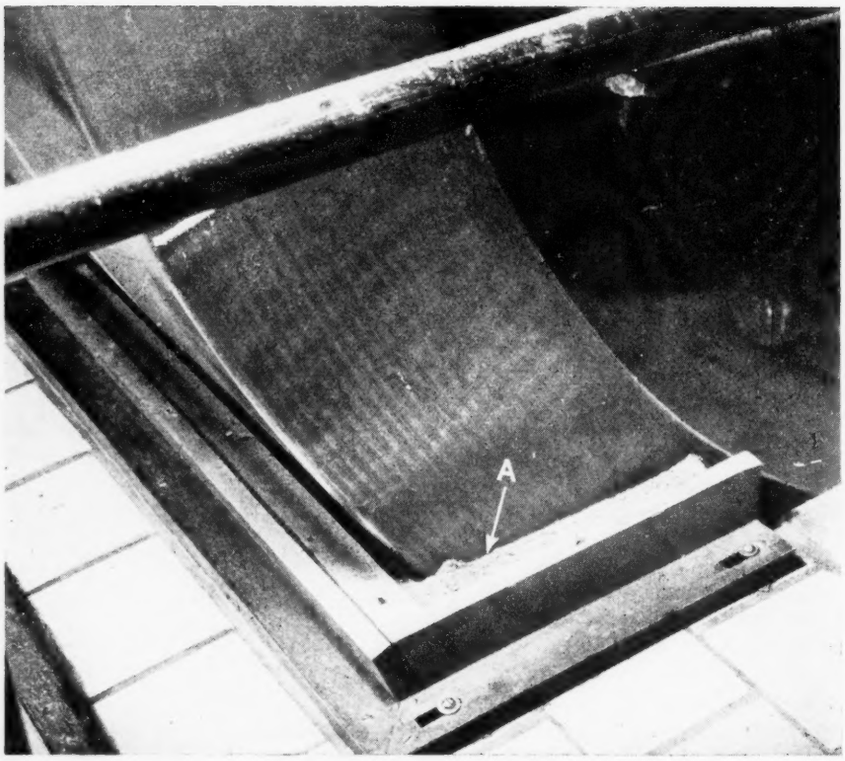
P-Bend Relieves Expansion Stresses

Provision for expansion and contraction at the ends of a suspension span carrying a high-pressure gas pipe line across a river usually calls for a horizontal loop or S-bend. Bends of these types, besides requiring considerable space, must be supported around the bend to prevent twisting strains on



the line. By using a P-bend, shown in the photo, in place of the usual lateral sweep, we have found that ample pipe for absorbing changes in length is provided, with 270 deg curvature in which to absorb stresses. The vertical bend does not require ground space other than that needed for the cable system. Guard posts to prevent colliding with the loop are the only extra material required outside of the pipe and bridge.

Houston, Texas Charles C Lynde



Oil Wiper Keeps Flywheel Clean

Wiping machinery while it is in motion is a dangerous practice, and is especially hazardous near engine flywheels. Oil accumulates on these wheels and by centrifugal force is thrown over the surrounding floors and ceiling, marring the appearance of the engine room. We had this problem in our plant and cured it with a device which wipes the flywheel without danger to the attendant, as shown at *A* in the photograph. This device consists of a light wooden frame mounted on the edge of flywheel pit, holding heavy sections of felt. These sections are adjusted to maintain light contact with the flywheel. We installed the wiper so that it contacts the wheel as its rim rotates out of the wheel pit.

New York, N. Y. Frank Smart
Chief Engineer, Beth Israel Hospital

Two Methods That Cut Gage-Glass Costs

On two of our boilers the water columns have gage glasses that are solid blocks of glass, 13.5 in. long, 1.25 in. wide and 0.75 in. thick. These glasses have a surface somewhat higher than their prisms that contacts the face of the water column. These boilers, designed for 450-lb pressure, operated for about 20 months at 165 lb g. While operating on the lower pressure the glasses were good for about four months service, or until the prisms became eaten away by steam action so that they could not reflect the water level in the glass.

It was after the boiler pressure was raised to 450 lb that our gage-glass troubles really began. Steam above the water level at this pressure has a severe action on the glass surface in contact with the gasket and cut the glass away in a very short time, causing a leak in the joint. To overcome this we used red lead and linseed oil in this joint on the surface of glass and gasket. This treatment in most cases doubled the life of the glasses. Before using the red lead we have had glasses cut out within 10 days and they never lasted longer than 25 days. With red lead they last from six weeks to two months.

Up until about one year ago when a glass cut out it was discarded. Then we tried grinding the surface in contact with the gasket. This practice has been successful and it only takes a few minutes to do the job.

For the grinding job a perfectly flat surface about 4 in. wide and 2 ft long is required. We use a good grade of grinding compound and sufficient water to keep the compound from getting sticky. The glass is held lengthwise on the grinding plate and moved forward and backward until a good surface is obtained. Since the prisms do not cut out as bad as they did on the lower pressure the glass is reinstalled with this slightly cut section below the water level. These practices have

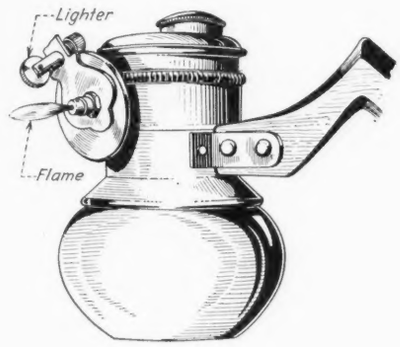
greatly extended the life of our gage glasses and reduced the cost of replacement proportionally.

Bismark, N. D. LESLIE BRADLEY

Leak Detector Made From Miner's Lamp

THE ILLUSTRATION SHOWS what I call my leak detector and it takes the guesswork out of finding live-steam leaks around flange gaskets in hot locations. This device is made from a miner's carbide lamp. I removed the reflector because it was in the way and made a holder for the flint lighter from an old lock key. To complete the job I added a handle from a glass coffee maker.

The flame from this lamp does not



change brilliance nor go out easily in ordinary air drafts. In the presence of the smallest amount of steam, however, the flame immediately changes to an orange color and with larger quantities it may be extinguished. Gasket and packing leaks can be detected during routine inspections long before they become serious and repaired during scheduled shutdowns. This little device can also ferret out vacuum leaks in condensers.

Grand Rapids, Mich.
WAYNE E HAMILTON

Arc Welding Saves Transformer Shutdown

BRACKETS WERE NEEDED TO INSTALL cooling fans on 33,000-kva, 88,000-volt transformers at the Ironwood substation of the Lake Superior District Power Co. The construction superintendent decided that arc welding was the only practical method of installing the brackets without shutting down all power and draining 25 bbl of oil from each transformer.

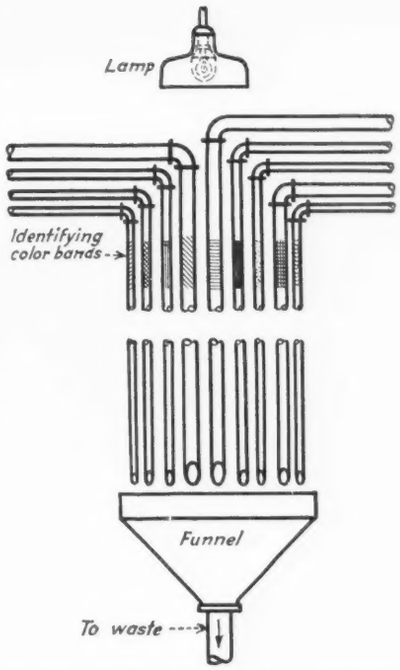
The job was accomplished by arc welding the brackets directly to the transformer radiators, which are constructed of metal less than ¼ in. thick. About 5-in. of weld was required, at four places on each transformer, all located within a 1-ft radius. One inch was applied at a time and allowed to cool before the arc was struck again, so that the oil inside the transformers would not catch fire. The arc welding was finished within three hours and the big transformers were kept on the line.

Troy, Ohio R P WAGNER
Hobart Brothers Co

Color Scheme Identifies Turbine-Drip Lines

DRIPS FROM LARGE STEAM TURBINES are usually made visible so that operators can easily detect conditions that effect plant performance. In one large industrial plant these drips lead into a funnel below the operating floor, where it was difficult to distinguish between the different pipes.

This difficulty was overcome by adequately lighting the funnel and identifying the pipes with a paint color band, as in the figure. Throttle-valve drains were painted aluminum; stage-drips, various shades of yellow; high-pressure-shaft-seal jet-condenser discharge, dark green; low-pressure-seal jet-condenser discharge, light green; and extraction-gear operating-cylinder drips and exhaust, blue and orange respectively.



Roanoke, Va. S H COLMAN

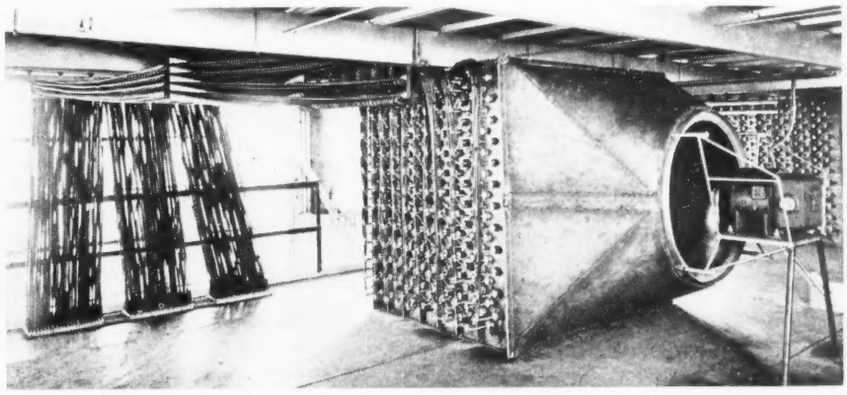
Special Load Resistor Speeds Diesel Testing

A LARGE DIESEL-ENGINE manufacturer recently required resistors that could be operated continuously at varying loads and voltages over long periods with few shut-downs. Another requirement was light weight, as the resistors were to be located between the roof trusses, throwing all the weight on the roof, as in the figure.

Fin Calrod heaters were selected for this job, and 240 of them rated 7-kw, 110-volt each were assembled in each resistor. This company now has 4 of these resistors installed, each mounted across a 6-ft square duct. A motor-driven fan blows 21,000 cu ft of air per minute through each resistor to dissipate the heat outdoors.

Each row of heaters is supported in the middle by a pipe running lengthwise in the duct. Large terminals for the wiring are provided outside the duct, away from the heat. Both terminal sides of the duct are insulated with 3-in. plastic insulation. This keeps heat away from the cables and also reduces the heat that must be dissipated into the roof of the building.

Schenectady, N. Y. R D KETNER
General Electric Co



Steam Table Drills—No. 1

How to Read the Tables

By PHIL SWAIN

WHAT BLACKSTONE IS to the lawyer, Bowditch to the sailor, Euclid to the mathematician, the dictionary to the author and the bible to the parson—that's what the steam tables are to the power engineer.

All college students in mechanical engineering are taught the common uses of these tables. Moreover, some self-educated power engineers have acquired real facility in their use. The fact remains that thousands of intelligent power engineers don't make adequate use of the steam tables.

Many of the latter will be glad to remedy this situation when they learn that the important uses of the steam tables are simple. That fact, we feel, will become amply clear to the POWER readers who will study this series of five or six articles.

This month we shall take a general look at one of the three principal tables and see what the labels mean. Fig. 1—(Excerpt of Steam Table 2) gives the properties of saturated water liquid and vapor for various pressures. Meanings of the various columns are explained in the caption.

In these articles the word "vapor" means steam and "liquid" means liquid water. Most engineers have a fair understanding of "saturation," but a little explanation will make it clearer: When water is exactly at the boiling temperature for the given pressure it is said to be at the "saturation point" or to be "saturated." The same is true of steam. For example, at atmospheric pressure (14.7 lb per sq in. absolute) the boiling temperature of pure water is 212 F. Either water or steam at 212 F is saturated if the pressure is 14.7 lb absolute.

At saturation the vapor and the liquid are in perfect balance; they can be in contact without either gaining at the expense of the other. If steam is in contact with water in a closed container both *must* be saturated.

For the benefit of engineers who are familiar with the older steam tables only, I should explain that "enthalpy" (accented on the *second* syllable) is the modern word for what used to be called "heat" in such expressions as "heat of the liquid," "heat of vaporization" and "total heat of steam." Reason for this change of name will be explained next month.

To get a better understanding of the steam tables, let's carry one pound of water through the various operations implied in the first line of the reproduced section of Table 2.

We start with 1 pound of water at 32 F. For theoretical exactness (in view of the definition of enthalpy given in the caption) this water will be subjected to an absolute pressure of 170 lb per sq in. as shown at *A*, Fig 2, and this pressure will be kept constant throughout subsequent operations. A vacuum above the piston eliminates the effect of atmospheric pressure, so that the indicated pressure is absolute.

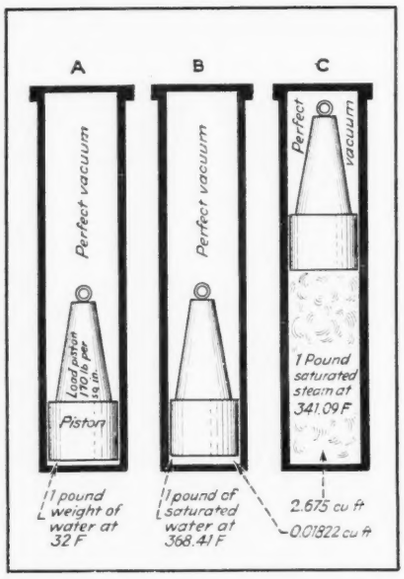


Fig. 2—Illustrating data on 170 lb line of Fig. 1. See text

Heated up to 368.41 F (B), water absorbs 341.09 Btu (Col 5), and expands slightly to 0.01822 cu ft (Col 3).

Any further heating must produce steam, because water at 170 lb pressure cannot get any hotter than 368.41 F and remain a liquid. Sketch *C* shows the cylinder at the exact moment of complete evaporation. Going from *B* to *C*, the heat put in (Col 6) is 854.9 Btu, and the increase in volume is 2.657 cu ft (not shown in Table 2). Final volume of the vapor is 2.675 cu ft (Col 4). Total heat supplied (above 32 F) is 341.09+854.9=1196.0 Btu.

Any further heating of the vapor, with the liquid all gone, will cause a rise in temperature above 368.41 F, the saturation temperature. This is called superheating and will be discussed next month.

Table 2. Saturation: Pressures

Abs. Press. Lb. Sq. In.	Temp. Fahr.	Specific Volume Sat. Liquid	Specific Volume Sat. Vapor	Enthalpy Sat. Liquid	Enthalpy Evap.	Enthalpy Sat. Vapor	Entropy Sat. Liquid	Entropy Evap.	Entropy Sat. Vapor	Internal Energy Sat. Liquid	Internal Energy Evap.	Internal Energy Sat. Vapor	Abs. Press. Lb. Sq. In.
p	t	v_f	v_g	h_f	h_{fg}	h_g	s_f	s_{fg}	s_g	u_f	u_{fg}	u_g	p
170	368.41	0.01822	2.675	341.09	854.9	1196.0	0.5266	1.0324	1.5590	340.52	771.4	1111.9	170
172	369.35	0.01823	2.645	342.10	854.1	1196.2	0.5278	1.0302	1.5580	341.52	770.5	1112.0	172
174	370.29	0.01824	2.616	343.10	853.3	1196.4	0.5290	1.0280	1.5570	342.51	769.7	1112.2	174
176	371.22	0.01825	2.587	344.09	852.4	1196.5	0.5302	1.0259	1.5561	343.50	768.8	1112.3	176
178	372.14	0.01826	2.559	345.06	851.6	1196.7	0.5313	1.0238	1.5551	344.46	767.9	1112.4	178
1	2	3	4	5	6	7	8	9	10	11	12	13	14

Fig. 1—Sample section of Table 2, "Saturation: Pressures". Entered with the saturation pressure, it gives the properties of saturated liquid and saturated vapor (see text for explanation). Following is a brief description of the numbered columns: 1—Saturation pressure, pounds per square inch, absolute. 2—Saturation temperature, degrees F. 3—The specific volume of the saturated liquid, measured in cubic feet per pound. 4—The specific volume of saturated vapor, cu ft per pound. 5—Enthalpy of saturated liquid. The heat that must be added to convert one pound of liquid at 32 F to liquid at the indicated temperature if pressure throughout heating is maintained constant at the value given in Column 2. 6—Enthalpy of evaporation. Heat that must be added to one pound of saturated liquid to convert it to 1 pound of saturated vapor (Entire operation takes place at saturation pressure). 7—Enthalpy of saturated vapor. Sum of columns 5 and 6. 8 to 13—Will explain in future. 14—Same as column 1

All references to steam tables in this series are to the "Thermodynamic Properties of Steam" (1936 Edition), by Keenan and Keyes, published by John Wiley & Sons, Inc, New York. Sections reproduced by permission of the publishers.

ARGUMENT CORNER

Removing a Cranky Crankpin

P M VAN WINGEN'S METHOD of anchoring a "Cranky Crankpin" is one which the writer has used in a similar situation, save that the method shown on page 113, POWER, November, 1941, does not suggest how the pin might be removed later, if this were necessary.

When using a tapered pin in a blind hole, such as the one shown, it is extremely difficult to withdraw the pin, as no adequate hold can be taken on it and driving out is, of course, out of the question. To permit its removal, we drilled a $\frac{1}{8}$-in. hole through the length of the pin before driving, reaming and tapping the out end of the hole to permit screwing in a pressure grease fitting. This hole we plugged with a $\frac{1}{8}$-in. pipe plug during driving to insure against distortion of the threads. The pin was driven with a hollow follower which avoided applying the blow at the threaded portion.

Then, to remove the pin at any time, it was necessary only to take out the plug, screw in the grease fitting, and with a grease gun and soft grease, apply any desired pressure through the hole to the bottom of the pin. If thin oil be used to build up hydraulic pressure under the pin, unless the fit is extremely accurate, pressure will be lost at the junction between crank pin and boss, and the pin may not budge. Use of heavy oil, with its consequent resistance to flow through close clearances, allows a high pressure head to be built up at the base of the pin. Once the pin moves, grease will ooze out around it, signifying its having been freed. After this the pin can usually be easily taken out.

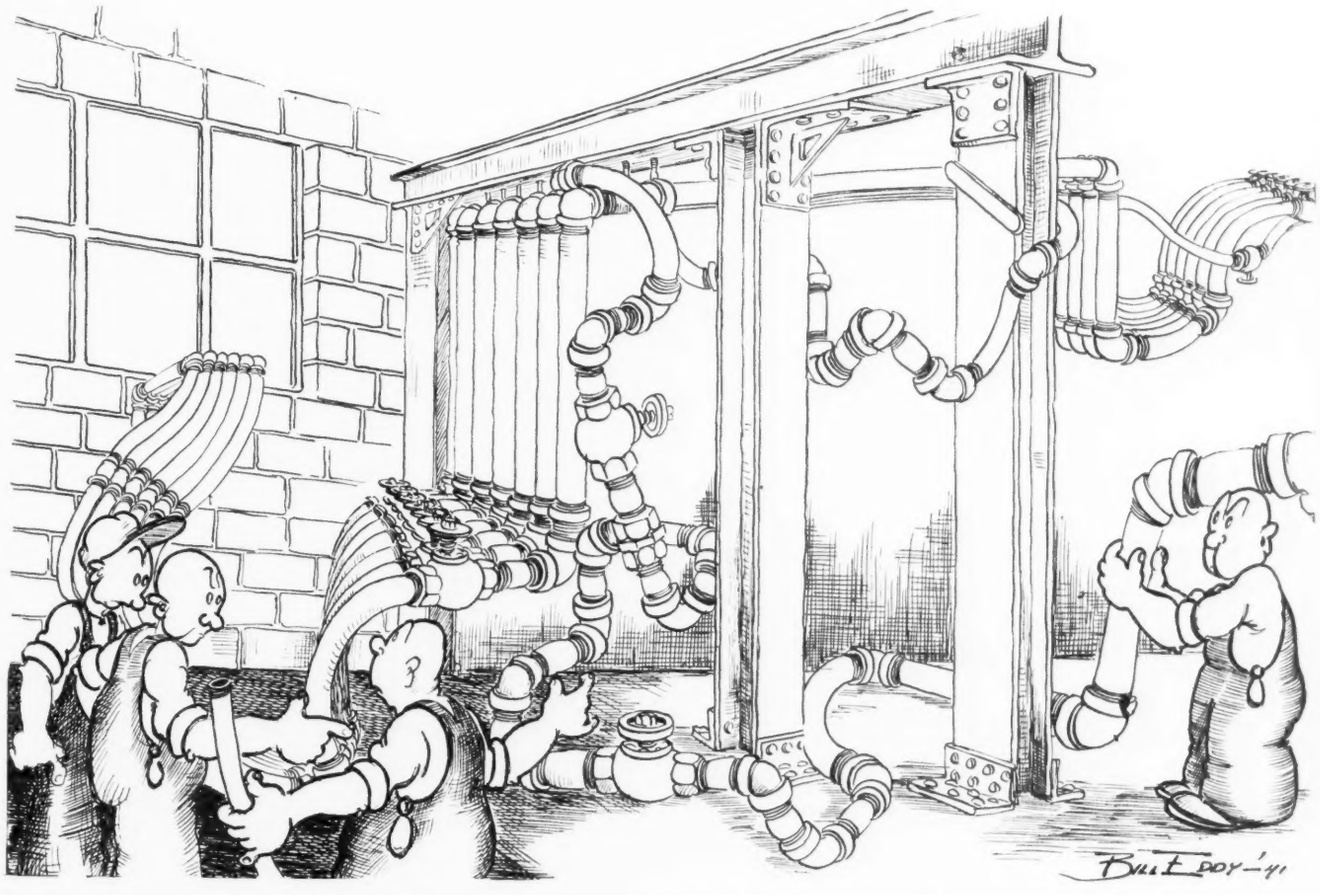
Houston, Texas CHARLES C LYNDE

More About Welding in Upper Boiler Head

MAY I RISE—at least as far as my typewriter keys—to object to a few of the points in A G Wiggin's article "Upper Head Welded in Vertical Tube Boiler," page 111, November, POWER. He says "After tack welding in position, the tubes should be installed . . . after which welding is completed." Why? The tubes are just in the way, and interfere with proper visual inspection of the work. In similar repairs on heat exchangers in oil-pipe-line and refinery work, the replacement head goes in for keeps before the tubes are placed. This leaves the replacement head free of obstructions which might tend to hinder the welder, permits it to heat up and then contract without outside forces tending to prevent true return in pre-welding status. This also enables the welder to check visually for the presence of any icicles or other irregularities in the bottom portion of his weld. How? By means of a small mirror, inserted through the nearest tube hole, and moved to show the bottom surface of the welded seam.

It has been my experience that heating and cooling of the replacement head

(*Continued on page* 132)

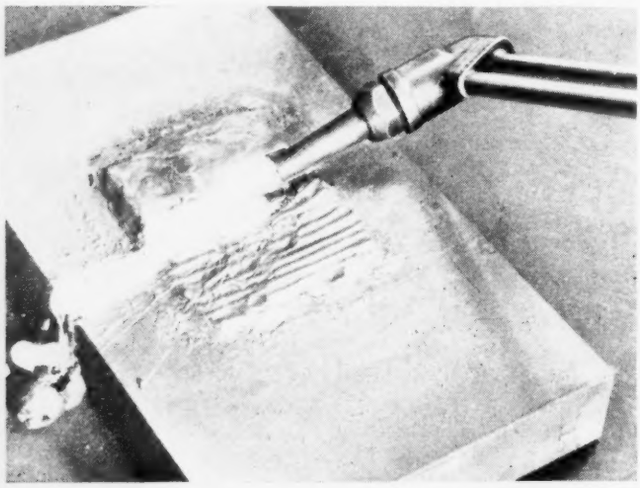


"Whaddaya mean, ya allowed a little for expansion?"

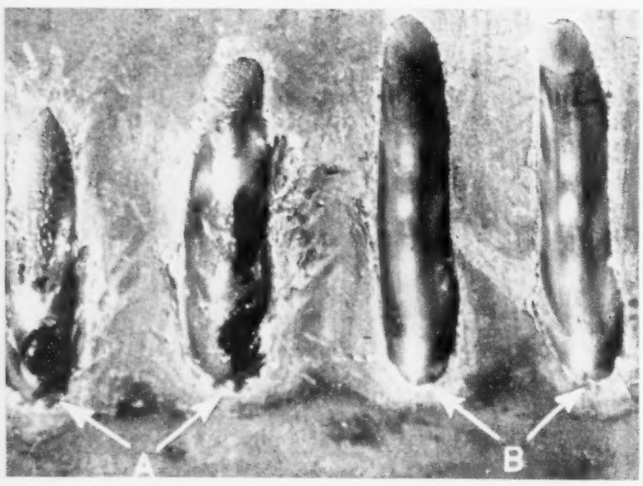
HOW TO TORCH-GROOVE STEEL

A NEW USE for the oxyacetylene torch is "grooving." A special groove-cutting nozzle is required. With proper control of torch movement and position, and gas pressures, clean and accurate grooves can be cut in a single pass in the surface of any steel having less than 0.35% carbon. Groove width may vary from $\frac{3}{8}$ to $\frac{15}{32}$ in. and depth from $\frac{1}{8}$ to $\frac{7}{16}$ in.

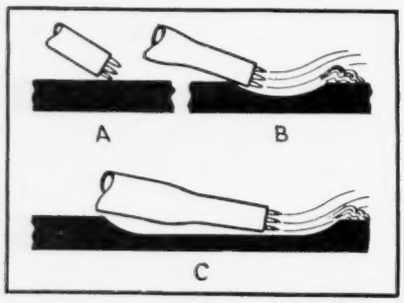
Here are possible applications: "Washing down" metal pads and other projections without injury to surface, rough-shaping steel, roughing out keyways, removing welds without injury to plate, removing cracks and defects, etc. The following instructions are based on information supplied by the Linde Air Products Co.



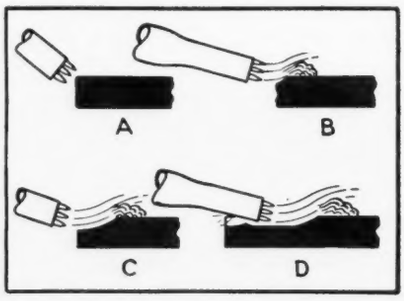
1—Pads, bosses and other projections on steel castings and shapes may be washed away without damage to the base surface. For smooth finish, final bumps are removed by grinding, filing or machine tooling



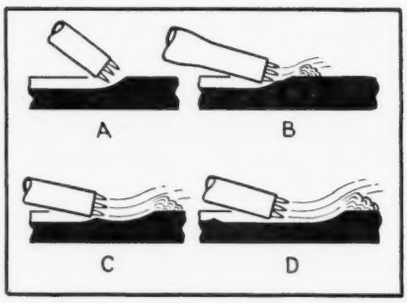
2—Right and wrong. Grooves *A* were started too slowly after the cutting oxygen was released, so that flame penetrated the ⅜-in. plate and melted side walls excessively. Grooves *B* were correctly started



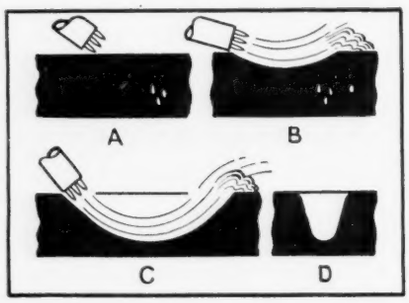
3—Instruction sheet supplied with equipment will give correct gas pressure. Light the blowpipe and adjust preheat flames to neutral with the cutting-oxygen valve open at the correct pressure. Then shut off the cutting oxygen and hold nozzle as at *A*, (slanted 20 to 40 deg) with inner cones of preheating flames just touching surface. When small molten spots begin to appear swing torch smoothly into position *B*, while gradually depressing the cutting-oxygen lever. Swing requires about 2 seconds. Then move nozzle in direction of cut, *C*, inclined 5 to 10 deg to horizontal. Don't let tip of nozzle touch the groove. Keep inner cones of preheat flames ¼ in. to ½ in. back of molten metal



4—To start a groove at the edge of a plate, preheat the plate edge in the usual way, *A*. Then raise nozzle above the edge with its angle reduced to the operating angle, and, *B*, lower nozzle (with the cutting oxygen on) so as to make a gradual cutting start until the desired depth of groove, *C*, is attained. Then move steadily in along the line of cut, *D*

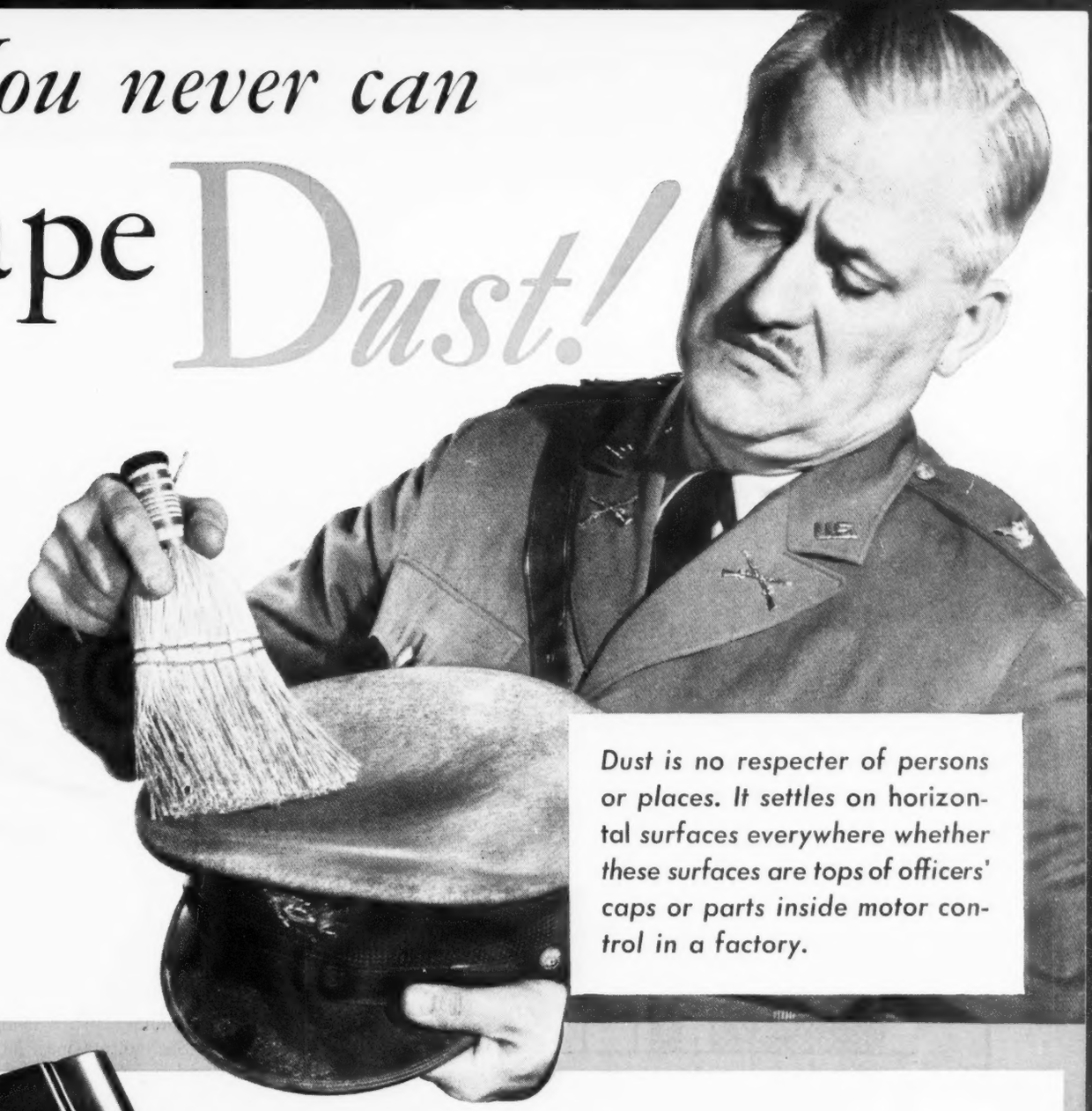


5—If a groove is interrupted or lost, the picking-up process is something like starting at an edge, as in 4. During preheating, *A*, direct the nozzle at the point where the groove stopped. Then gradually turn on the cutting oxygen while swinging the torch to the cutting angle, *B*. Make a gradual starting cut until the proper depth, *C*, is reached. Then move, *D*, along the line of the cut



6—To remove defect buried in the steel start preheating, *A*, at a point in the rear of the defect (distance depending upon the depth of the defect). Then, as cut is started, draw nozzle back slightly and lower the angle, *B*. Next gradually increase angle, *C*, so that cut is increasingly downward until defect is reached and removed. Weld U-shaped groove, *D*.

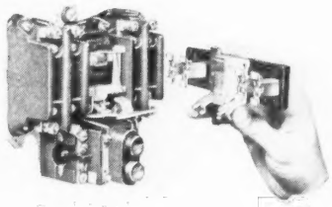
You never can Escape Dust!



Dust is no respecter of persons or places. It settles on horizontal surfaces everywhere whether these surfaces are tops of officers' caps or parts inside motor control in a factory.

Because dust is so commonplace, it is very easy to underestimate the trouble it can cause in modern electrified manufacturing. And *that* is too serious to ignore in these days when interruptions to production are not only a hazard to industrial efficiency but to national security as well. This is no time to take chances. Guard *your* production with dependable Cutler-Hammer Motor Control, the Motor Control that uses dust-safe VERTICAL contacts exclusively . . . the contacts that *can't* collect dust, that *stay* clean to work better and last longer. Specify Cutler-Hammer and *see* the difference. CUTLER-HAMMER, Inc., 1358 St. Paul Avenue, Milwaukee, Wisconsin. *Associate*: Canadian Cutler-Hammer, Ltd., Toronto.

Cutler-Hammer Vertical Contacts are the mark of *better* Motor Control, another extra dividend on Cutler-Hammer's unequalled specialized experience and decades of Motor Control leadership.



CUTLER-HAMMER
MOTOR CONTROL
C-H

Dust Safe VERTICAL *Contacts*

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Safe Ramps For Coal-Handling Walkways

Another helpful article on how to make power plants safe for the operating personnel by W Elwood Rossnagel, safety engineer for Consolidated Edison Co of New York

▶ IN MANY LOCATIONS where the difference in floor elevations is not great, ramps may be found more desirable than stairs or ladders as a means of transportation. This is particularly true where it is required to get wheeled equipment from one level to another without using elevators. Most ramps are of limited length, such as from the ground up to a truck-loading platform, although they are now common in multi-storied garages and in inclined-belt-conveyor galleries where the total rise may be 100 feet or more.

These drawings help standardize for the designing engineer and draftsman the design of ramps from a safety viewpoint. However, it is fully realized that such an undertaking is difficult, as almost every installation will have its own peculiarities. A number of the figures here presented have been arbitrarily chosen, but experience in the field has found them satisfactory.

Ramps, as a general rule, are not recommended for pedestrian traffic as the hazard of slipping or tripping is ever present. In railroad stations and similar locations ramps are in common use, but their slope is usually limited to a very gentle grade. Where the grade reaches or exceeds an angle of 10 deg to the horizontal (which corresponds to a rise of $2\frac{1}{8}$ in. in 12 in.) it is desirable to install cleats in the floor to afford a better foothold.

Such cleats may be constructed in various manners, being made of wood slats, ridges of concrete, steel traps bolted to the floor, or abrasive metal inserts in the floor. While the abrasive

(*Continued on page* 118)

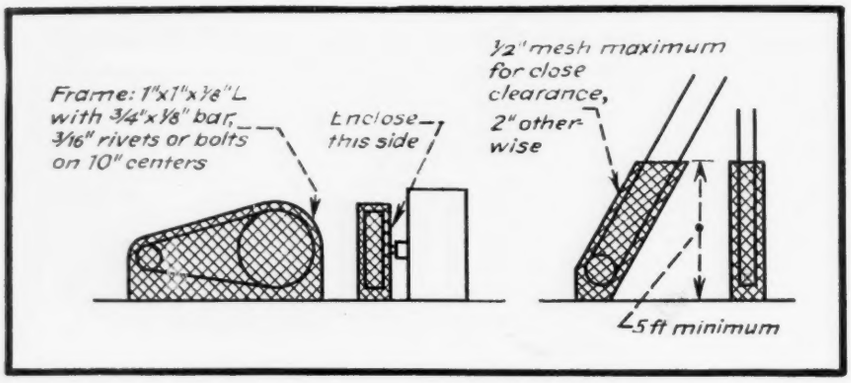

Frame: 1"x1"x⅛" L with ¾"x⅛" bar, 3/16" rivets or bolts on 10" centers
Enclose this side
½" mesh maximum for close clearance, 2" otherwise
5 ft minimum

Fig. 1—Standard gear and belt guards of woven wire, expanded, perforated or sheet metal should have openings not greater than one-half inch for close clearance and should extend at least 5 ft above floor

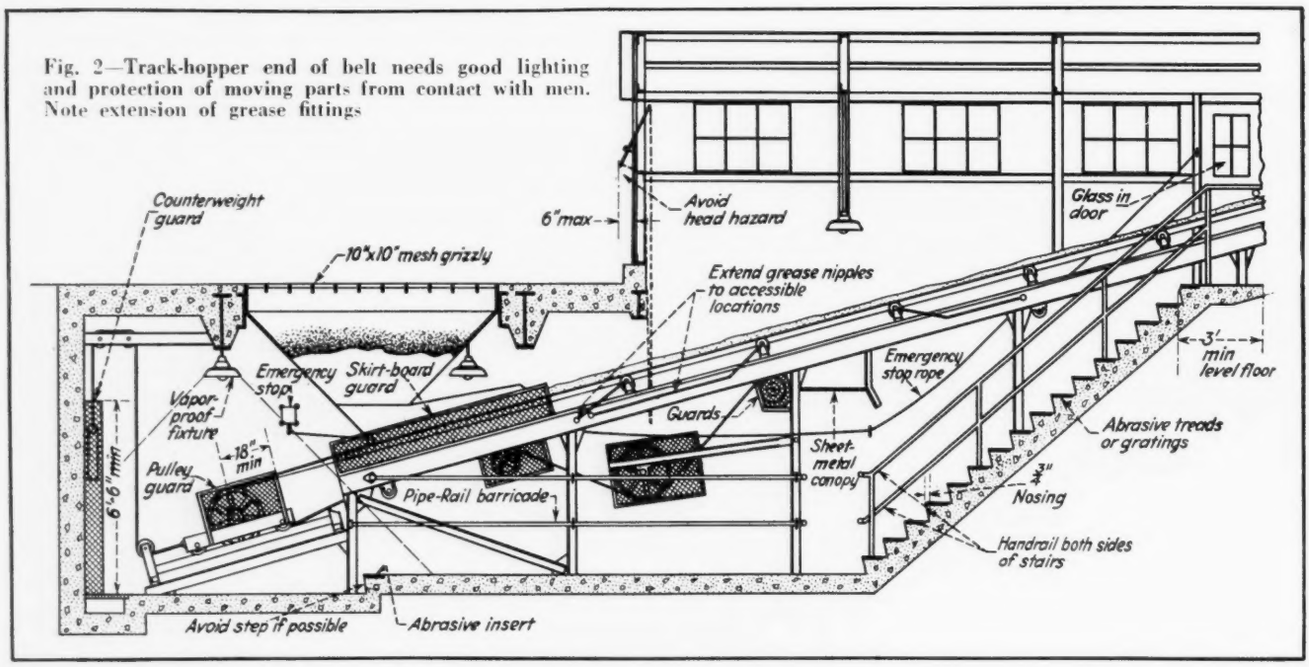
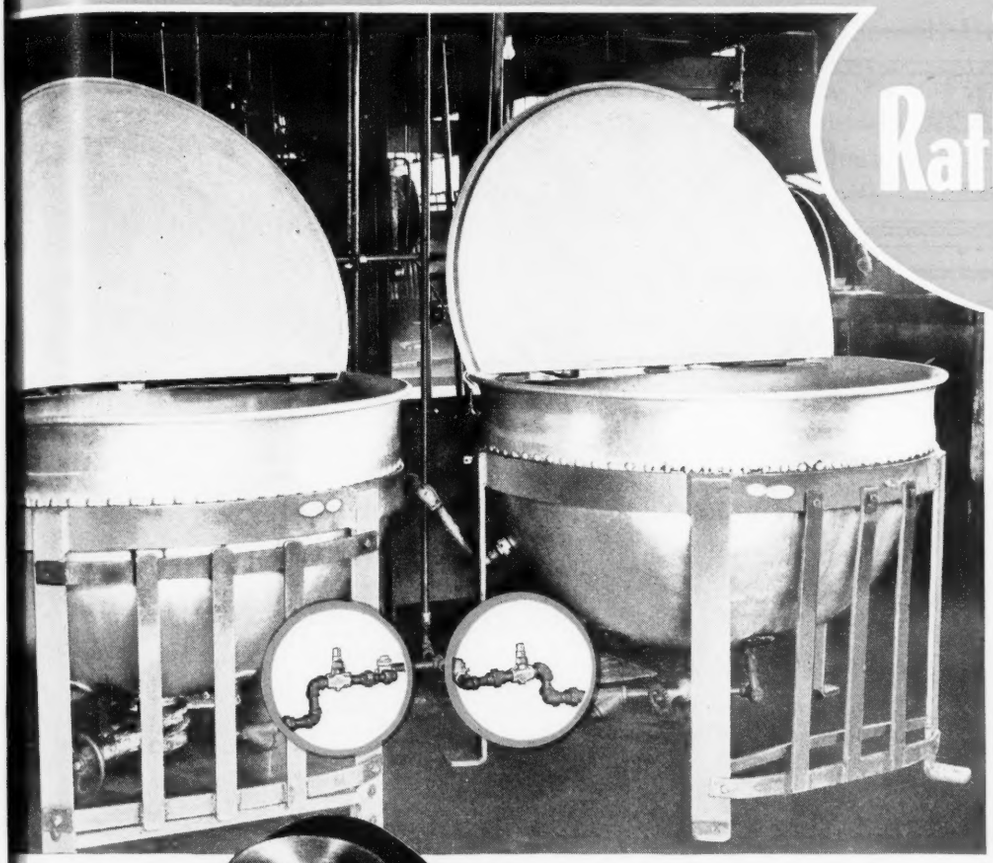
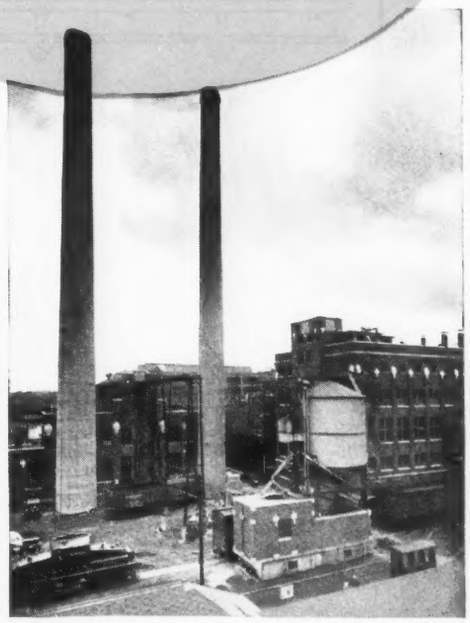


Fig. 2—Track-hopper end of belt needs good lighting and protection of moving parts from contact with men. Note extension of grease fittings

Over Four Hundred Yarway Impulse Traps SERVE Rath Packing Co.





FOR five years, the Rath Packing Company, Waterloo, Iowa, have used Yarway Impulse Steam Traps in their smoke houses, on unit heaters, on coil and pipe drains, on cooking or processing kettles (as shown above), and for various other services throughout their vast plant.

The fact that the number of Yarway Impulse Traps put to work by this company has grown from a few trial units to several hundred during the past 5 years is testimony to the satisfaction that these efficient little traps have given on the job.

You can solve your trapping problem by standardizing on Yarways. They provide *quicker heating; greater sustained heating efficiency; lower installation and maintenance cost; fuel economy; saving in valuable floor space* due to their small size.

Then too, you probably can install new Yarways for *no more than the cost of repairing* the *old traps* in your plant. It's often the case.

See your mill supply dealer—or write for Catalog T-1736.

YARNALL-WARING COMPANY
100 Mermaid Ave. Philadelphia

YARWAY IMPULSE STEAM TRAP

Safe Ramps for Coal-Handling Walkways

(Continued from page 116)

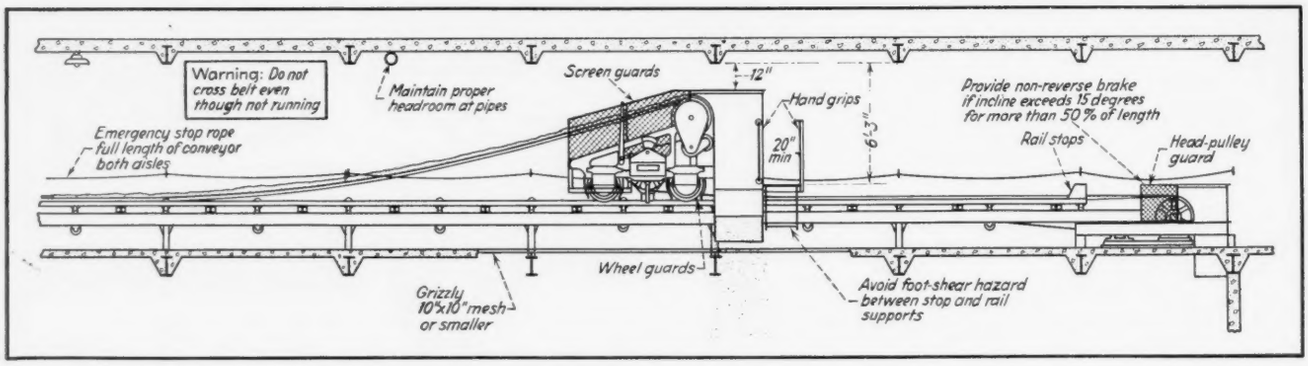

Warning: Do not cross belt even though not running
Maintain proper headroom at pipes
Screen guards
12"
Hand grips
20" min
6'3"
Provide non-reverse brake if incline exceeds 15 degrees for more than 50% of length
Rail stops
Head-pulley guard
Emergency stop rope full length of conveyor both aisles
Wheel guards
Grizzly 10"x10" mesh or smaller
Avoid foot-shear hazard between stop and rail supports

Fig. 4—Working above coal bunkers can be made safer by emergency-stop rope and careful attention to tripping and falling hazards

inserts are somewhat wider, it has been found that cleats about ½ in. thick and 2 in. wide are very satisfactory. These cleats should extend to within 3 in. of each side of the ramp, being discontinued only if and where required for the passage of vehicle wheels. For comfort in walking up and down the ramp it will be found desirable to place cleats 22 in. apart.

From the power-plant engineer's standpoint, perhaps the most common use for ramps is along inclined belt conveyors; special consideration should be given to such installations. Where the angle of the ramp is 10 deg or greater, there should be provided on one side, preferably the right side when descending, a single-member pipe handrail about 42 in. vertically above the floor. When going down a long ramp some persons are inclined to become dizzy, and it is for such men as well as for any who should slip or trip that the hand grip is provided. On wide ramps hand-grips should be provided at both sides of the passageway.

Moving machinery near ramps or stairs is even more hazardous than on level floors or platforms because of the tendency of a falling man to reach for the nearest object. Of course handrails should be provided but chain drives and belt pulleys should be guarded with mesh or plate strong enough to resist the force of a falling man. If guards have to be placed at close clearance, less than about 4 inches, mesh should be one-half inch or less. If the guard is more than finger length from the machinery larger mesh up to 2-inch may be employed.

When constructed at an angle in excess of 15 deg ($3\frac{5}{16}$ in. in 12 in.) it is desirable to provide horizontal treads instead of cleats. For safety and

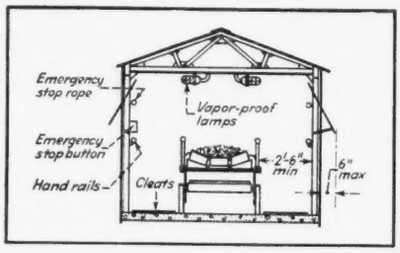


Fig. 5—Conveyor housing, showing location of safety features and indicating minimum clearances

for ease in ascending and descending, such steps should be as properly proportioned as stairs, the height of the riser plus the effective depth of the tread (exclusive of any nosing) being between 17 and 17½ in.

Where the lower end of a ramp is adjacent to the head of a stair, it is essential that a level landing be pro-

(Continued on page 120)

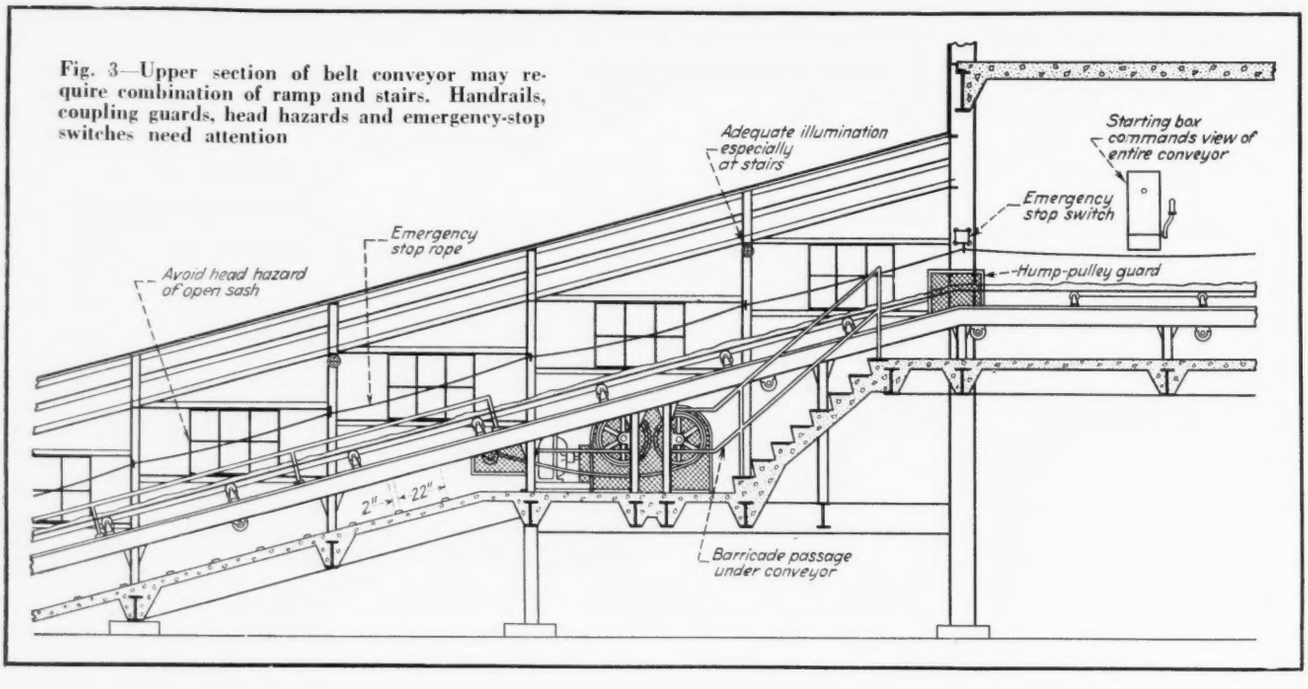
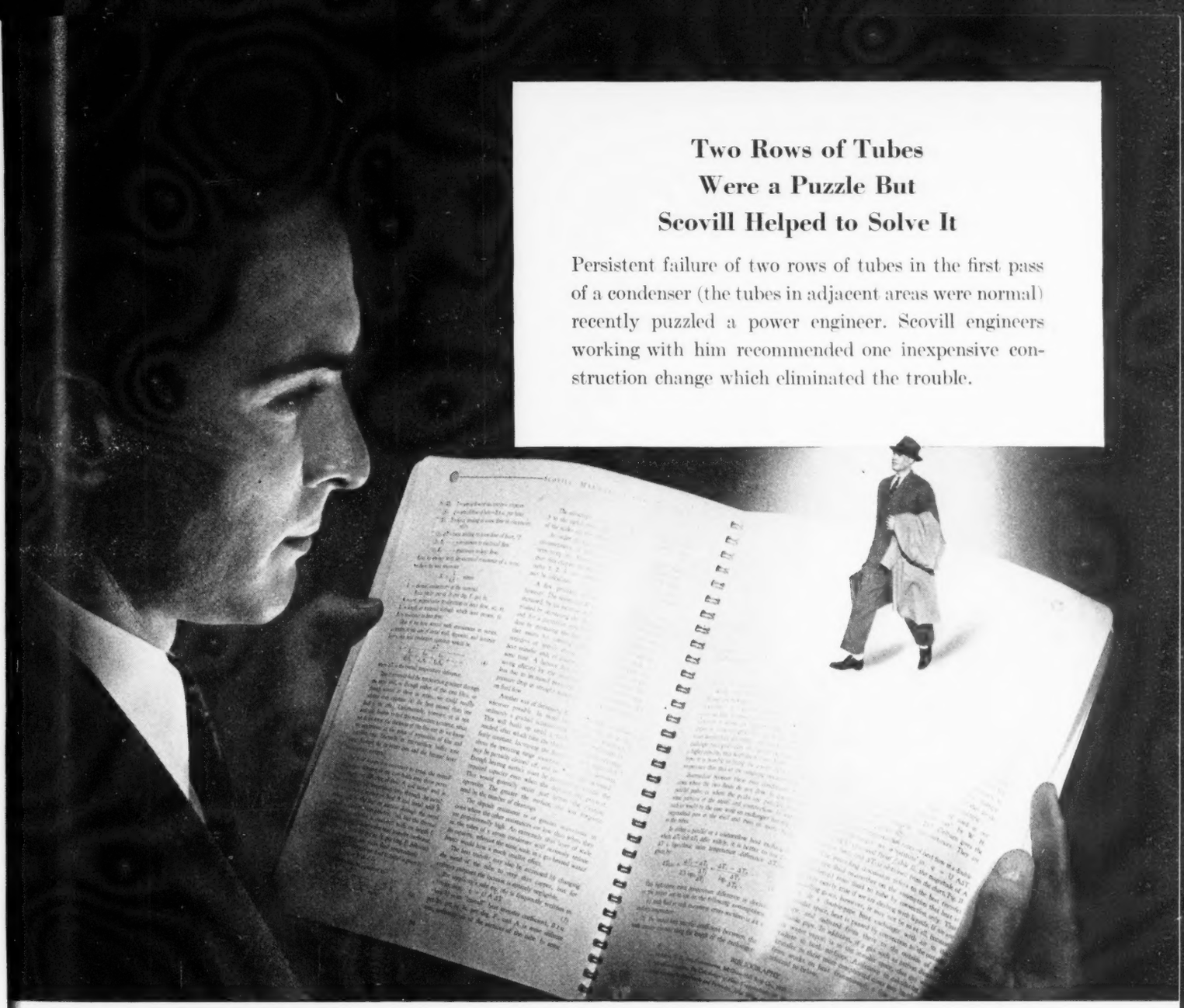

Adequate illumination especially at stairs
Starting bar commands view of entire conveyor
Emergency stop switch
Emergency stop rope
Avoid head hazard of open sash
Hump-pulley guard
2" x 22"
Barricade passage under conveyor

Fig. 3—Upper section of belt conveyor may require combination of ramp and stairs. Handrails, coupling guards, head hazards and emergency-stop switches need attention



Two Rows of Tubes Were a Puzzle But Scovill Helped to Solve It

Persistent failure of two rows of tubes in the first pass of a condenser (the tubes in adjacent areas were normal) recently puzzled a power engineer. Scovill engineers working with him recommended one inexpensive construction change which eliminated the trouble.

Call on the man between the lines

To Help Solve Your Condenser Tube Problems

$$R = \frac{Dvp}{u} = \frac{DG}{u}$$

. . . and the combined experience of the men who serve Scovill heat exchanger customers is almost sure to equal a practical, economical solution of any tube difficulties you may encounter.

Much of this combined knowledge is contained in our new Heat Exchanger Tube Manual; but beyond that, you'll find the man *between the lines* well qualified to help you in your special problems whether it be corrosion of metals, methods of installation, fluid flow, heat transfer, or specifications.

Should that problem involve Reynolds' number . . . the transition point between viscous and turbulent flow . . . dezincification . . . vaporization . . . or merely the standard tolerances for seamless tubing . . . we can probably promptly supply exactly the information you need — background information that springs from the practical experience of Scovill consultants who have helped to solve problems like yours.

The revised edition of the Scovill "Heat Exchanger Tube Manual" is reserved for distribution to engineers and other technical men whose positions frequently require them to have access to a source of material which covers many of the more unusual aspects of heat exchanger tube engineering and operation.

For an informative source for those problems having to do with the manufacture, material selection and installation of Condenser Tubes, Scovill's Service in Manuals has produced another booklet — "Scovill Condenser Tubes" available on request. Write to Scovill Manufacturing Company, 13 Mill St., Waterbury, Conn.

★ ★ ★ ★ ★ ★ ★

Scovill, for many years a regular source of supply for the U. S. Government, is cooperating in every way to forward defense plans. When deliveries are not as prompt as our customers desire, we hope they will realize that delays are sometimes unavoidable, and part of the price paid for National Defense.

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ONE PRODUCT...THREE SERVICES

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- **SERVICE IN MANUALS**

Safe Ramps for Coal-Handling Walkways

(Continued from page 118)

vided, otherwise a very dangerous condition is presented. Such a landing should be at least three feet long. Also, where the ramp is at the foot of the stairs a level landing should be installed, although it need not be so long.

Ramps which are intended for wheeled vehicles, whether manually or mechanically propelled, should not have a rise in excess of 15 ft between landings. Even then, the successive ramps of a series should not be in one straight line which might permit a runaway vehicle to race down more than a single ramp. Between ramps of lesser rise the horizontal landing should have a length not less than one and one-half times the wheelbase of the longest vehicle.

If these few suggestions are followed as far as local conditions permit and if the floor surface is reasonably rough so as to reduce the slipping hazard, ramps should prove acceptable from a safety viewpoint.

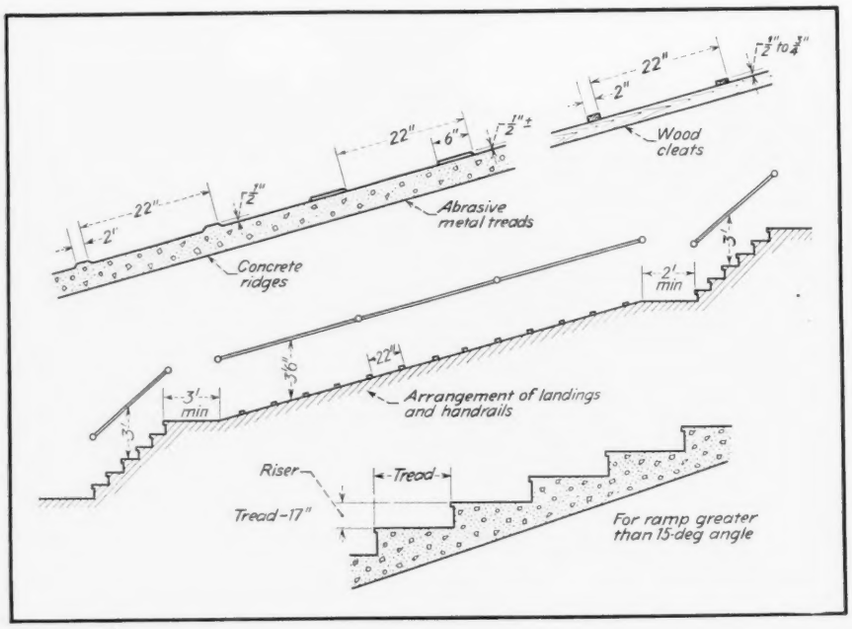


Fig. 6—Arrangement of landings and handrails for combination ramp and stair. Also shows detail of ridges and cleats

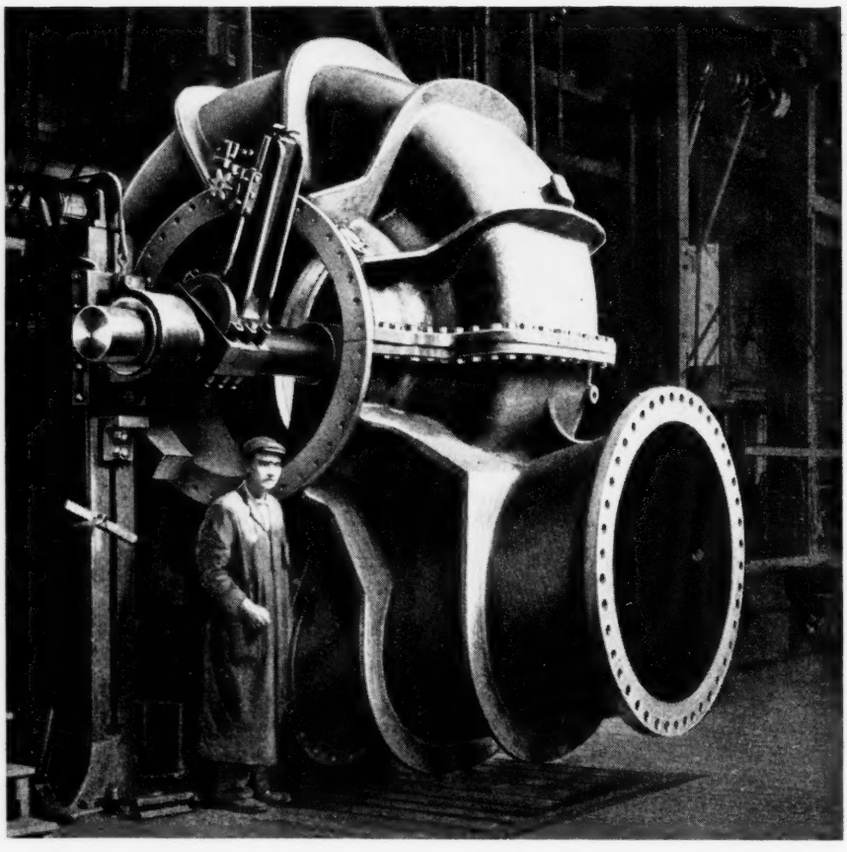
✧ ✧ ✧

Pumps for Pearl Harbor

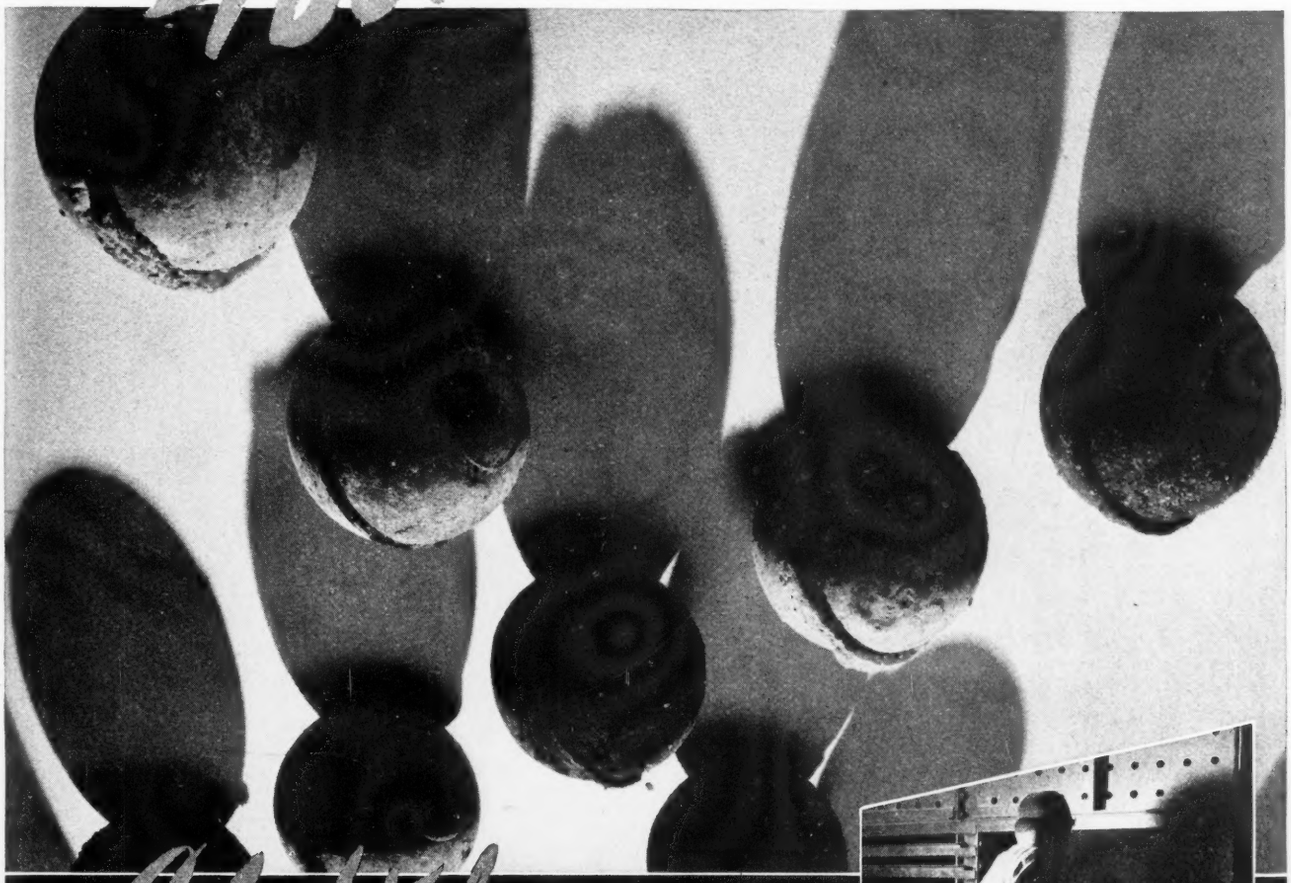
► One of the largest pumping plants ever built is being installed in the U. S. Navy Drydock at Pearl Harbor, Hawaii. Pumps for the plant were furnished by the Morris Machine Works, Baldwinsville, N. Y.

The four main 54-in. pumps, one of which is shown, each have a capacity of 130,000 gpm against a total dynamic head of 20 ft. They are vertical-shaft units and are set in the dock approximately 60 ft. underground. These pumps are to operate at 277 rpm and are each driven by a 1250-hp motor. The total capacity of more than half a million gpm is sufficient to supply the normal requirements of a city the size of Detroit.

In addition to the four main pumps, other pumping equipment includes two 12-in. auxiliary drainage pumps, driven by 250-hp motors, one 8-in. auxiliary drainage pump, driven by a 75-hp motor, two 3-in. sump pumps, motor driven by 10-hp units, two 4-in. sewage pumps, powered by 25-hp motors and one 4-in. sewage pump driven by a 15-hp motor. The smaller units have a total capacity of over 10,000 gpm.



4000 POWER PLANTS



Glad To be BEHIND THIS 8 BALL

Inset photo in Nalco plant, Chicago, Ill.

HERE is an 8 ball that power plants throughout the country are glad to be behind! It is the Nalco No. 8 Water Treatment Ball— and its chemical action in Nalco distributors keeps feedwater lines and water pipes clear of choking incrustation wherever water conditions demand its use. This Nalco chemical ball is only one of a multitude of compounds used by Nalco Engineers in solving water treatment problems in every phase of industry. When plants must be kept operating at top efficiency, the complete Nalco System is one sure way to eliminate the unnecessary costs and delays raw feedwater can cause. Write today for data on a free Nalco Survey of your plant. There is no obligation —a possibility of better, more economical plant performance.

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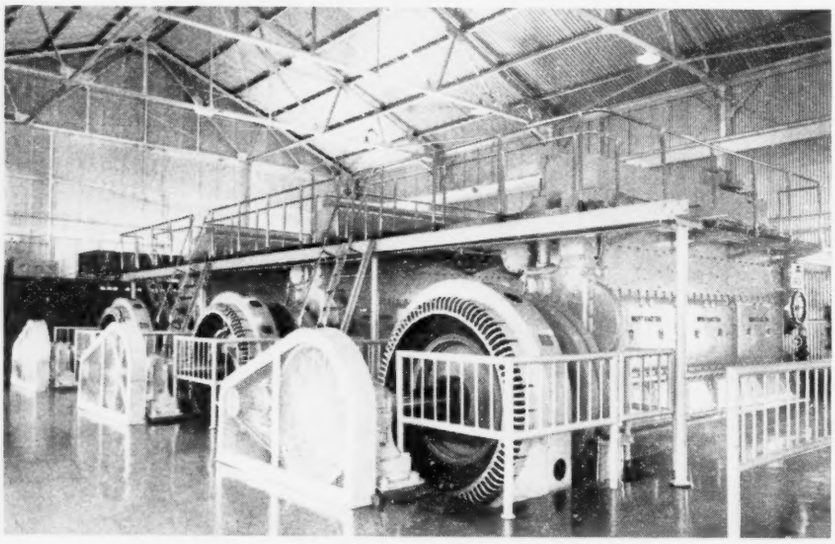
— the Complete Water Treating Service

Nalco

Gas-Engine Plant Powers an Oil Field

Following new trend, central station with three convertible engines supplies current for well pumps and for gasoline, water-pumping, and salt-water-disposal plants at Magnolia Petroleum's Fitts field operation



Three identical 690-hp engines now operate on gas, but can be converted to 750-hp diesels in two 8-hr shifts

AN EFFICIENT GENERATING PLANT, operated by the Magnolia Petroleum Co at Stonewall, Okla., supplies all power requirements for that company's extensive operations in the Fitts oil field. All the motor-driven pumps depend for power on this central station. In addition, the station serves a gasoline plant, a water-pumping station and a salt-water disposal plant.

Use of central generation represents a relatively new development in oil-field power methods and is fast gaining popularity among the major producers. The traditional technique involved hooking a small gas engine to each well pump in the field. This had the advantage of utilizing the superabundant supply of gas for fuel but it had a number of disadvantages in operation and maintenance. Gasoline plants, pump stations and salt-water-disposal plants either purchased power at comparatively high rates or ran their own power plants.

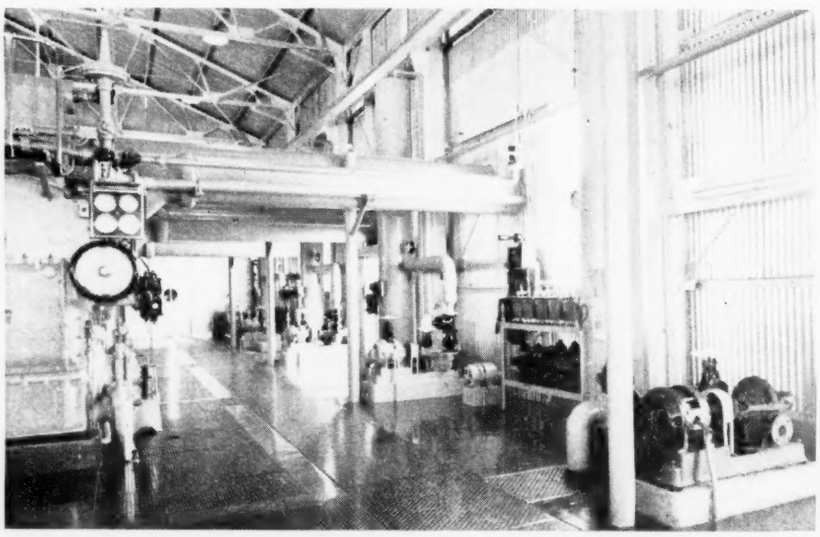
Engineers of the major companies saw the value of concentrating under one roof all power production for the varied field activities. Under this system, it is economically possible to maintain experienced supervision over all power equipment. At Fitts field, a chief engineer and operating staff takes charge of power production and a chief electrician cares for transmission lines and all the motors in the field. No one else need do more than push a starter button or throw a switch to obtain power.

The prime movers at the heart of this production system are three identical, 690-hp, 4-stroke-cycle, convertible Worthington engines operating on natural gas. Each drives directly a 500-kw, 0.8-pf, 4160-volt, General Electric alternator with 15-kw, V-belted exciter. To supply all requirements, two engines operate constantly; the third serves as standby. Load never drops below 500 kw, and rarely goes above 800. Average kilowatt-hour production for each 24-hour day is 15,000 and this is maintained over the year.

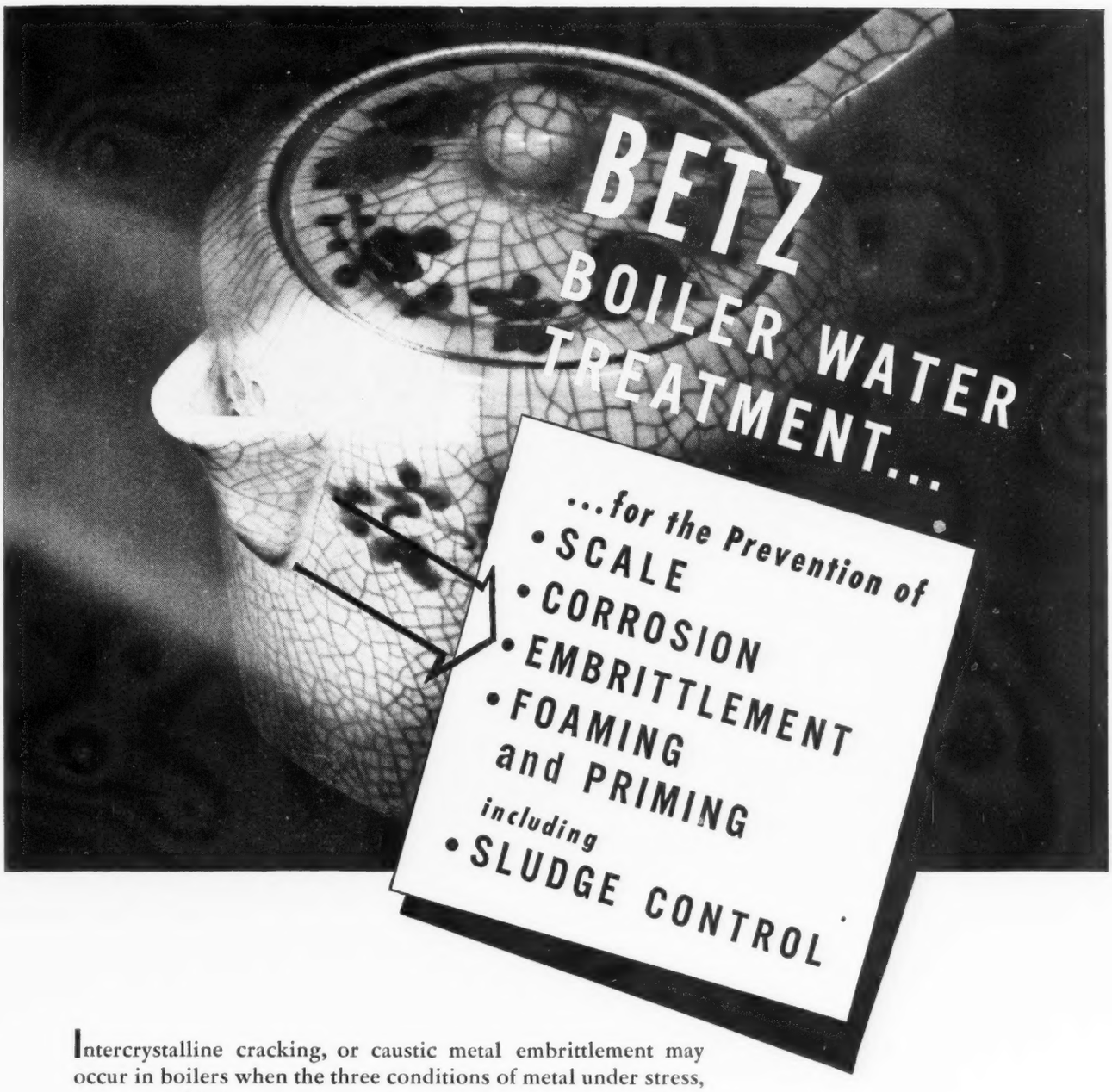
Casinghead gas with 1100 Btu per cu ft heating value serves as fuel for the engines. At present, the supply of gas is abundant but the company has made provision for a day when it will be more economical to use oil for fuel. The 6-cyl, 16x20-in. engines, now delivering 690 hp at 327 rpm on gas fuel, were designed to permit conversion to oil operation in little time and at small cost. Functioning as diesels, without change of bore, stroke or speed, each unit will deliver 750 hp. Under laboratory conditions, an engine can be switched from gas to diesel operation in less than six hours. Even in the field, Chief Engineer M L Richardson estimates that his regular crew can make the change easily in two 8-hour shifts.

For gas operation a ring, set between each cylinder and its respective cylinder head, contains the spark plugs. In the changeover, this ring is removed and the head bolted directly to the cylinder, thus increasing compression to the level necessary for the full diesel cycle. Both

(*Continued on page* 124)



Rear end of engines showing instrument panels on each, and accessories along wall



Intercrystalline cracking, or caustic metal embrittlement may occur in boilers when the three conditions of metal under stress, presence of leakage in seams or tube-ends, and chemical action between boiler water and stressed steel exist simultaneously.

Betz engineers make use of an Embrittlement Detector, in which the first two conditions are synthetically established to determine if the third condition exists and the boiler water is, in fact, embrittling. If found necessary, recommendations are then made for the prevention of cracking by inhibitive boiler water treatment.

The Betz Organization is devoted exclusively to consultation, research and supervision in the field of water conditioning... from plant design to plant operation. In the solution of any and all water problems, Betz renders a complete service.

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Gas-Engine Plant Powers an Oil Field

(Continued from page 122)

head and ring have matching water connections so that no attention need be given to the cooling-water system when the change is effected. The head has a dummy spray valve in position and this can be replaced quickly with the working fuel-oil spray valve. The engine frame is drilled for the fuel pumps.

When the spark-plug ring is removed it is obvious that the elbows connecting intake and exhaust headers to the cylinder will no longer fit. All that is necessary, however, is to switch the intake and exhaust elbows and both will serve in their new roles. At present, the governor controls the gas-mixing valve but the engine is arranged so that the control can be shifted to a rod running the length of the engine with connections to the fuel pumps.

The gas comes from the residue line of the gasoline plant at 40 lb; a regulator drops pressure to 14 oz before entrance to the header. At each engine another regulator reduces the gas to atmospheric pressure before it enters the mixing valve. Air for each engine passes through an oil-bath filter outside the plant, then through a header to the mixing valves. The richness of the mixture can be regulated by hand; the governor controls quantity of mixture admitted to the cylinder. An air line, running from the crankcase to the intake header, creates a slight vacuum in the crankcase, which improves ventilation.

Each engine has a rotary ignition system supplied by a 12-volt battery set. Individual coils for each spark plug mount near the cylinder head so that high-voltage wires from coil to plug are kept short. Both a rectifier and a small motor-generator set are available for battery charging.

Mechanical lubricators supply cylinder walls, while oil for the bearings and for cooling the pistons comes from a pressure system. Oil for the pressure system is picked up from a sump tank by an engine-driven gear pump, put through a six-unit disk filter, and a cooler, and then sent to the bearings and pistons, finally draining back to the sump. Bypassing oil around the cooler or regulating the quantity of water flowing through the cooler controls oil temperature.

A motor-driven gear pump takes oil from the bottom of the sump and delivers it to a centrifuge which discharges clean oil into the top of the sump. The centrifuge runs continuously and piping is arranged so that it can serve one engine at a time. Each engine is provided with a motor-driven helical gear pump as auxiliary lubricating-oil pump. This runs to bring up oil pressure before an engine is started and to keep up oil circulation when an engine is cooling down. The auxiliary also can be used in case the main lube-oil pump fails.

Each of the three engines is served by a centrifugal pump, direct-connected to a 7½-hp motor, which circulates water through the cylinder and cylinder-head jackets, the jacketed exhaust header and through the individual shell-and-tube heat exchanger located just outside the plant. A manifold is arranged so that any one or any combination of the heat exchangers can be used to cool water for any one or any combination of engines. One of two motor-driven centrifugal pumps circulates raw water through the heat exchangers and sprays it over an atmospheric cooling tower. The second pump serves as standby.

Actually, no "raw" water is used in this cooling system. All water for the plant and the residence camp comes from a nearby stream, pumped into a 1600-bbl tank where 40 lb of lime and 7 lb of soda ash are added for each 12,000 gal of water. Drinking water for the camp passes through a small but complete filtration plant with settling basin, sand filter and carbon filter. Water for the engine jackets is treated in a zeolite softener and stored in a supply tank for use as makeup when needed.

A gage board at the control end of each engine holds a multi-point exhaust pyrometer and air-, water- and oil-pressure gages. An alarm sounds if water temperature goes above 165 F or lubricating-oil pressure drops below 15 lb. If engine speed goes above a predetermined limit, an overspeed switch breaks the circuit in the primary coils of the ignition system.

Exhaust gas from each engine passes into a header and then out to vertical silencers just outside the plant. There are two starting-air compressors: one is driven through V-belts by an electric motor, the other is similarly connected to a small gasoline engine. The two units are so arranged that belts can be shifted and the motor used to drive either compressor.

Principal Power Equipment

Magnolia Petroleum Co, Stonewall, Okla.

Generating Equipment

Engines, 3.....Worthington Pump & Machinery Corp
6-cyl, 16x20-in., 4-stroke cycle, 327-rpm, 690-hp convertible units
Generators, 3, direct-connected.....General Electric Co
4160-volt, 3-phase, 60-cycle, 0.8-pf, 500-kw units with 15-kw, 125-volt, belted exciter
Governors, Type IC.....Woodward Governor Co
Gas-pressure regulators.....Pittsburgh Equitable Meter Co
Exhaust silencers.....Maxim Silencer Co
Air filters.....Vortox Mfg Co
Starting-air compressors.....Worthington Pump & Machinery Corp
Ignition system.....Scintilla Magneto Div
Batteries.....U S L Battery Corp
Rectifier.....Westinghouse Electric & Mfg Co
Motor-generator set.....Robbins & Myers Co

Cooling-Water System:

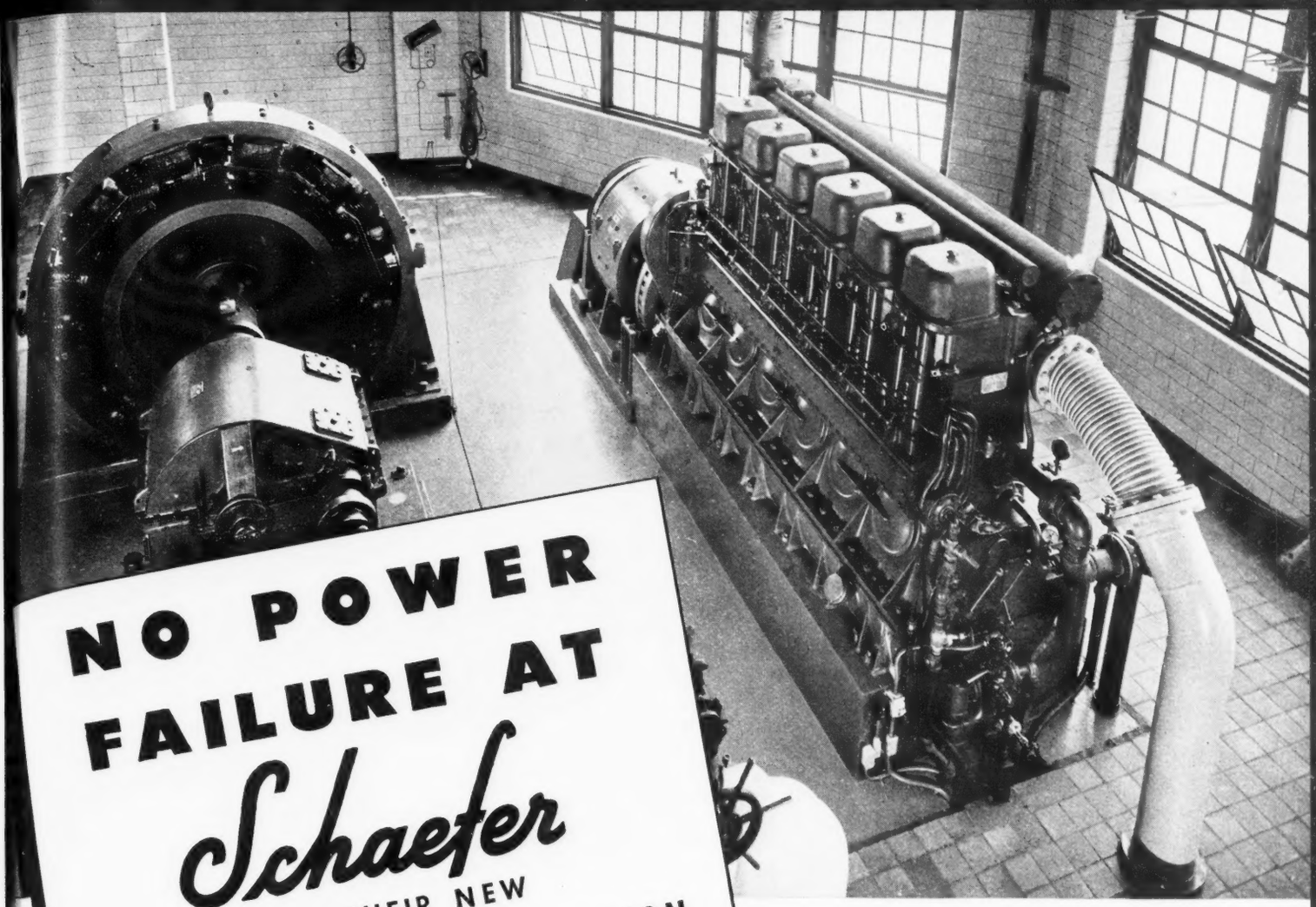
Jacket-water and raw-water pumps
Worthington Pump & Machinery Corp
Heat exchangers.....Henry Vogt Machine Co, Griscom-Russell Co
Cooling tower.....Marley Co
Zeolite softener.....Morey & Morey, Inc
Filtration plant.....International Filter Co
Cooling-water alarm.....Crouse-Hinds Co

Lubricating-Oil System:

Lubricating oil, DTE extra heavy.....Magnolia Petroleum Co
Coolers.....Ross Heater & Mfg Co
Filters.....Cuno Mfg Co
Mechanical lubricators.....Manzel Bros
Transfer and auxiliary pumps..Worthington Pump & Machinery Corp
Centrifuge.....Sharples Corp
Lubricating-oil alarm.....Minneapolis-Honeywell Regulator Co

Miscellaneous Equipment:

Switchboard, voltage regulators, synchroscope.....General Electric Co
Crane.....Euclid Crane & Hoist Co
Exhaust pyrometers.....Illinois Testing Labs
Pressure gages.....Manning, Maxwell & Moore



NO POWER FAILURE AT *Schaefer* WITH THEIR NEW DIESEL-STEAM COMBINATION

Power failure problems were eliminated at The F. & M. Schaefer Brewing Company's Brooklyn plant when this new 6-cyl., 600-hp De La Vergne diesel engine was recently installed alongside the steam turbine also shown. Thus the inherent dependability of diesels in the ultimate emergency is again exemplified.

"Two necessary services will be performed by the diesel," says Fred Ophuls, consultant and designer of the plant, "The first of these is to meet the demand for current for lighting and operation of small motors over weekends; the second is the ability to continue the racking and bottling of the beer, should some emergency force the steam plant to shut down. Our experience with the engine seems to indicate that we have been able to fulfill these requirements with the unit we have installed."

Your best assurance for an uninterrupted power supply is a De La Vergne diesel. Known throughout the country for their dependable and economical operation, De La Vergne diesels are available in sizes from 200 bhp to 1,500 bhp. Let De La Vergne engineers investigate your power problem.

Baldwin De La Vergne

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ENGINEERS' BOOKSHELF

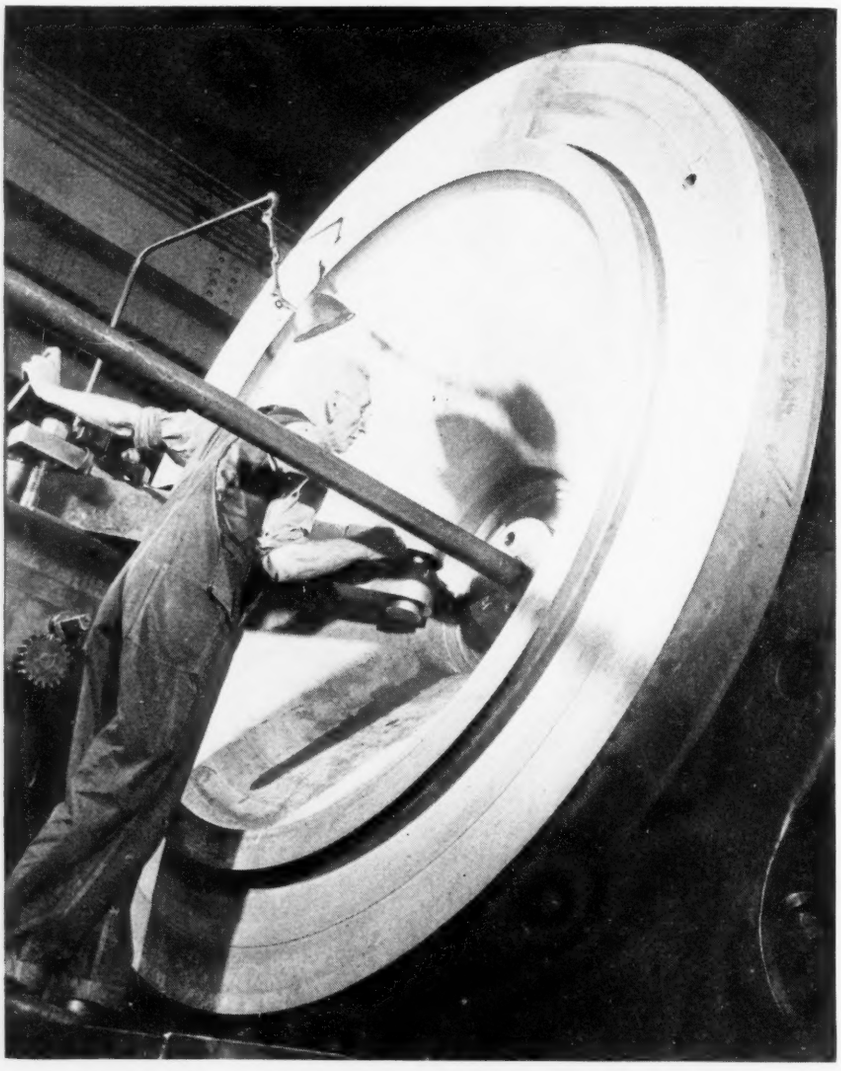
Wiring

WIRE AND WIRE GAGES—1941. *By F J Camm. Published by Chemical Publishing Co, Inc, 234 King St, Brooklyn, N. Y.* 138 *pages,* 4½x6½ *in.; illustrated:* 85 *tables; fabroid binding. Price* $2.50.

Eighty-five tables giving the characteristics of different kinds of wire form the major portion of this little book. Wire sizes are given in several gages, such as the Standard Wire Gage, sometimes referred to as the British Imperial Wire Gage; Birmingham Wire Gage; Brown & Sharpe or American Wire Gage; Stubs Iron Wire Gage and Stubs Steel Wire Gage and others. Wire sizes are not only expressed according to the different gages but also in inches and in millimeters. The book closes with several pages on wire rope and how to handle it. Those interested in wire gages used in Europe and in America will find this book handy.

ELECTRIC WIRING SPECIFICATIONS. (First Edition, 1941). *Edited by Earl Whitehorne with collaboration of Electrical-Contracting editorial staff. Published by McGraw-Hill Book Co, Inc, 330 W 42nd St, New York, N. Y. 181 pages, 6x9 in.; illustrated; tables; cloth binding. Price* $2.50.

Good specifications produce a good wiring job for the owner and protect the profits of the contractor. Poor specifications make trouble for everyone concerned. It is to help accomplish the first objects that this book has been compiled. A design and specification procedure is presented against which engineers, architects and contractors may check their practices. The work includes wiring for light, power and signal systems, modern standards, engineering data and diagrams. It gives designing engineers, estimators, contractors, and others an orderly, accurate procedure that simplifies their work and contains helpful guiding rules for planning and specifying wiring systems that comply with the National Electrical Code.



An additional 36,000 kw for war industries in the Tennessee Valley will be produced when this generator shaft flange begins to turn at Pickwick Dam. John Kelcker, veteran Westinghouse machinist, is shown machining the inner surface of the flange. This bell-shaped flange connects to a similar flange on the servomotor between the turbine and generator shafts. The servomotor controls the blade angle of the turbine runner. This 45-ton flanged shaft rotates at 81.8 rpm. Complete generator is now under construction at the East Pittsburgh Works of Westinghouse

Electricity

NEMA LARGE AIR-CIRCUIT-BREAKER STANDARDS. *Published by the National Electrical Manufacturers Association, 155 E 44th St, New York, N. Y. 30 pages, 8x10½ in.; stiff paper binding. Price 75 cents.*

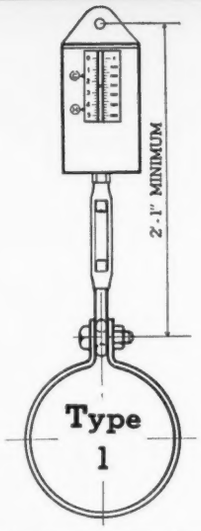
This standard is divided into four parts. The first gives the scope of the large air-circuit-breaker group and classes of standards. Part II deals with commercial, general, rating, manufacturing and application standards. Definitions comprise Part III and in Part IV are given instructions for the installation, operation and care of large air circuit breakers. Anyone interested in air-break circuit breakers will find this standard very helpful.

LINCOLN'S INDUSTRIAL COMMERCIAL ELECTRICAL REFERENCE—(First Edition, 1941.) *By E S Lincoln, consulting engineer. Published by The Electrical Modernization Bureau 60 E 42nd St, New York, N. Y.* 1200 *pages,* 8½ *x* 11 *in.;* 326 *illustrations;* 315 *tables, cloth binding. Price* $15.00.

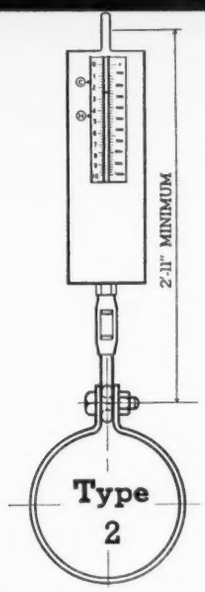
This is one of the monumental works of the electrical industry. In it the entire field of industrial electric operations from service entrance through utilization equipment is covered. It is divided into 25 sections and each section devoted to service or utilization equipment is divided into installation and operation. Installation covers economic factors, selection of equipment, layout, application and control. Operation includes inspection, maintenance, testing, surveys, analysis of perform-

(*Continued on page* 146)

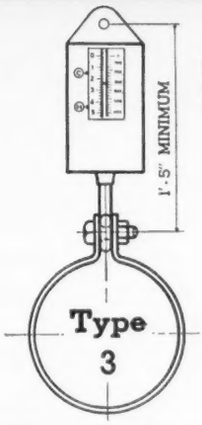
This is the line of POWER PIPING *"Functional Type"* HANGERS *which improve and simplify complicated piping systems*



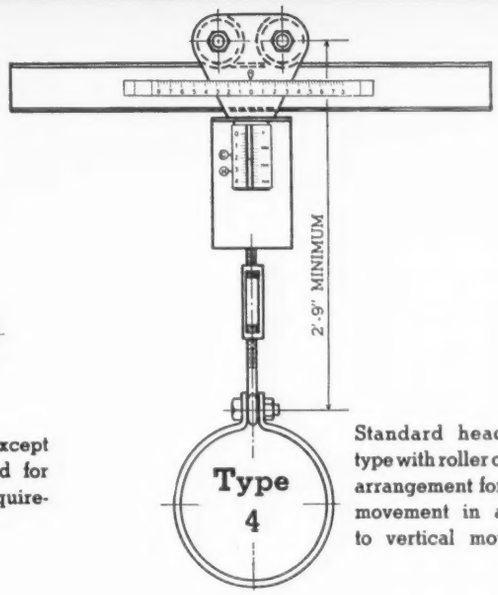
Standard single spring type designed for rigid fastening to supporting structure with built in bell type swivel allowing limited angular movement in any direction.



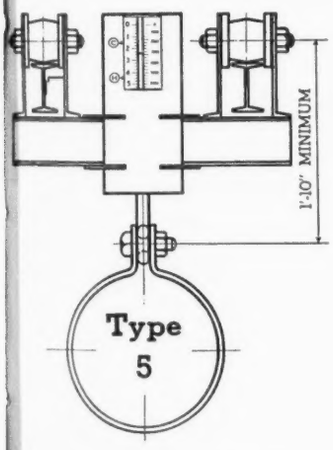
Same as type 1 except for double spring.



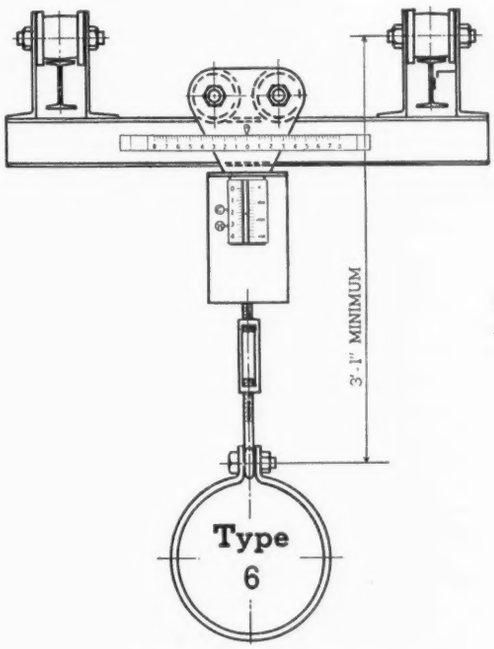
Same as types 1 and 2 except that hanger is arranged for minimum head room requirements.



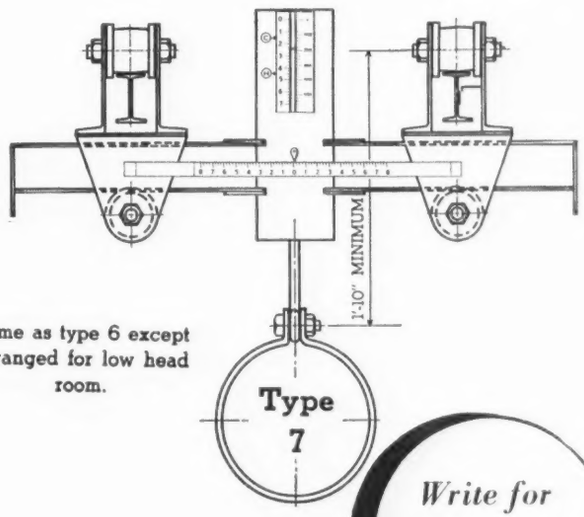
Standard head room type with roller carriage arrangement for lateral movement in addition to vertical movement.



Same as type four except arranged for low head room conditions.



Double carriage arrangement provides for movement in any direction.



Same as type 6 except arranged for low head room.

Write for Illustrated and Descriptive Catalog No. 1815

BLAW-KNOX COMPANY
POWER PIPING DIVISION

1525 PENNSYLVANIA AVE., PITTSBURGH, PA.

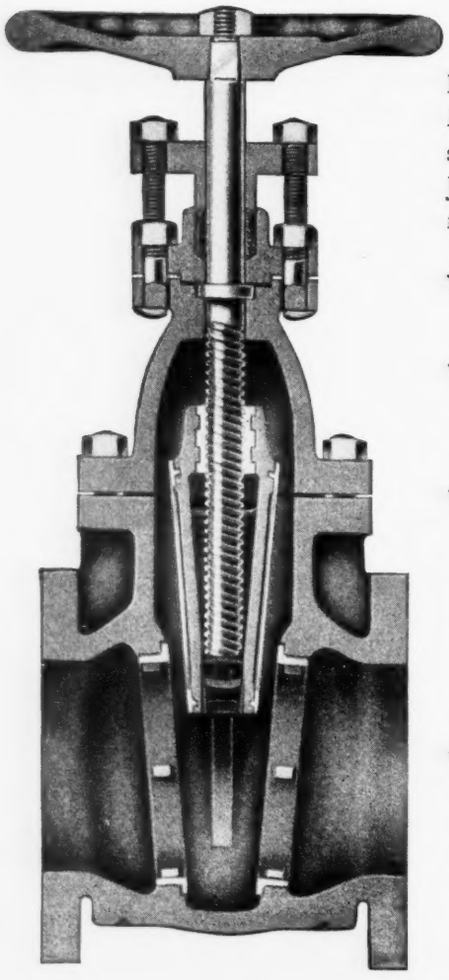
FROM GOOD VALVE DESIGN

FOR EVERY INSTALLATION

Specify the Iron Body Gate Valves that

LAST LONGER!
CUT MAINTENANCE!

WHEN YOU BUY Jenkins Valves you buy valves of *proved* quality. For, on file at Jenkins Bros. you can find records – totaling more than 30,000 valve years – of actual Jenkins installations that have given trouble-free service for as much as a half century or longer. Proof, if there ever was, of better *materials,* better *workmanship,* better *design* in Jenkins Valves!



Check – See For Yourself!

Examine a typical *"Jenkins" – Fig. 326 Iron Body Solid Wedge Gate Valve* – and see for yourself point-by-point how a Jenkins Valve excels in fine features that mean longer life and less maintenance!

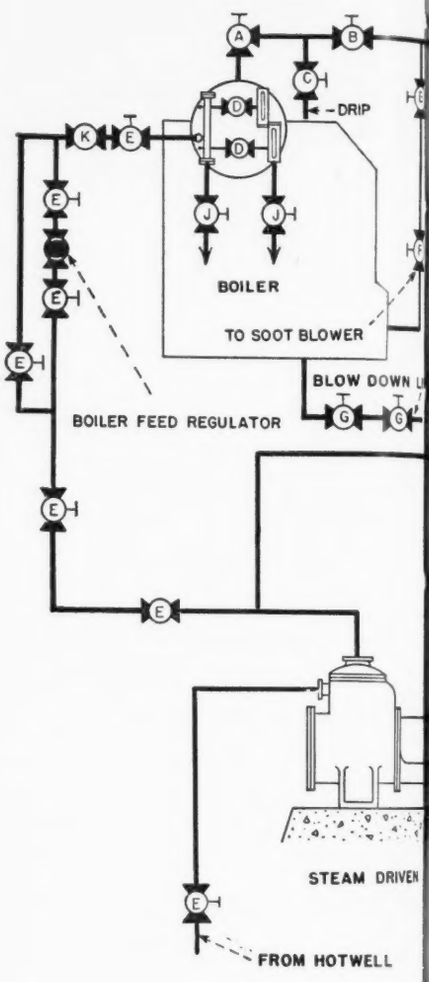
★ **WHEEL** – big, easy-to-operate. Designed so you can really grip it!

★ **BONNET** – heavy and of full height to allow wedge to lift clear of line. Attached to body by through bolts.

★ **SPINDLE** – Made heavy, of bronze that boasts tensile strength of 55,000 lbs. per square inch. Has plenty of precision threads, Acme, Standard, of correct pitch and lead for practical balance between operating speed and ease.

★ **WEDGE** – the solid wedge is reversible, and machined and gauged to standards that guarantee unvarying uniformity of taper in wedge and seat. Made of bronze in sizes to 3 in. . . . larger sizes of iron with bronze faces rolled in. Deeply milled lugs on both sides engage ribs in body to enforce accurate seating, and minimize drag and chatter.

FOR BOILE



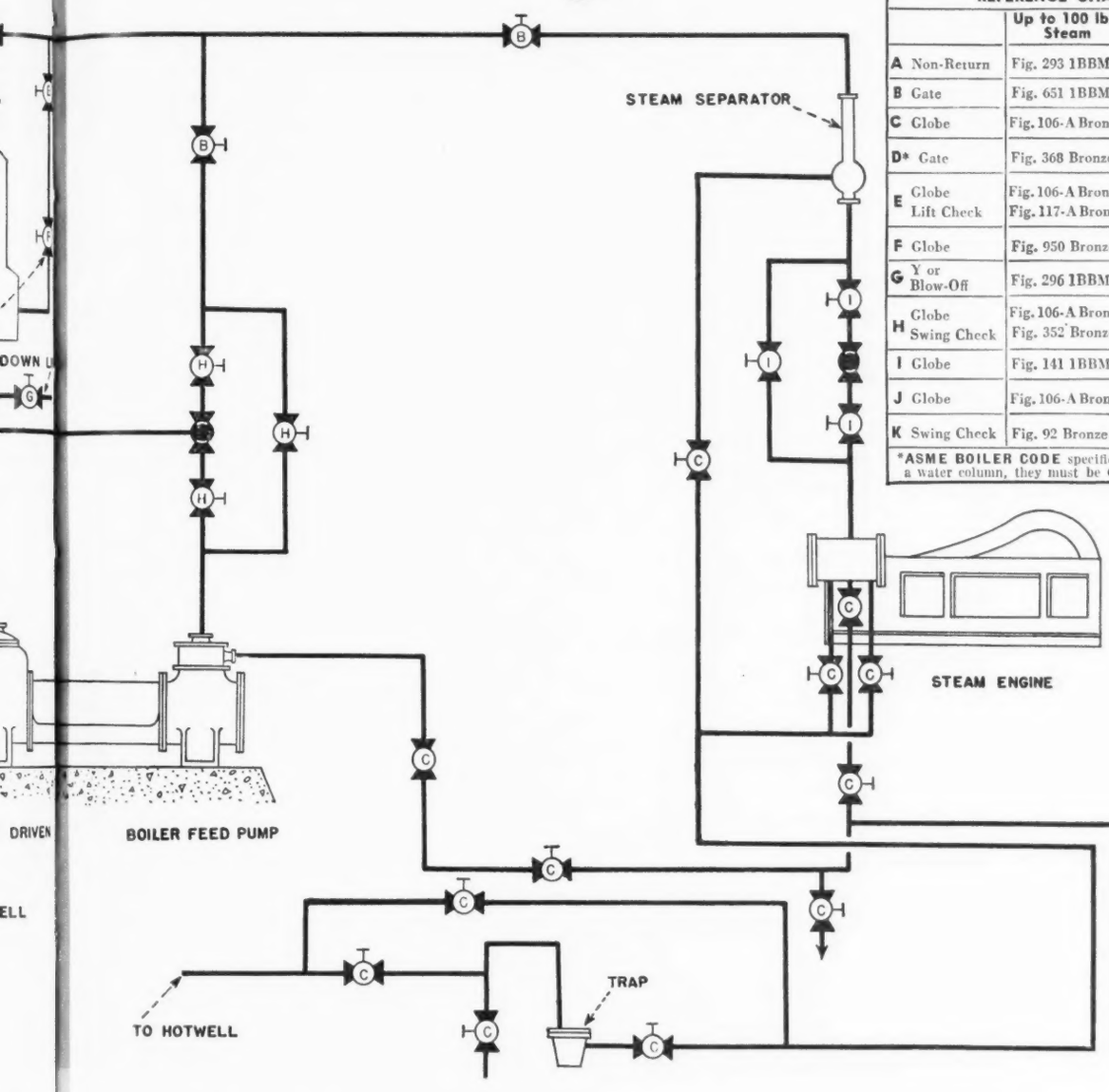
★ **SEAT RINGS** – renewable bronze seat rings, machined to "watch-movement accuracy" are screwed into the body.

★ **BODY** – a husky, generously proportioned casting of evenly distributed "semi-steel" having an average tensile strength of 34,000 lbs. per sq. in.

There's a JENKINS VALVE for every need

TO GOOD VALVE PRACTICE

CONNECTIONS *Jenkins* RECOMMENDS



REFERENCE CHART FOR JENKINS FIGURE NUMBERS				
	Up to 100 lbs. Steam	Up to 200 lbs. Steam	Up to 240 lbs. Steam	
A Non-Return	Fig. 293 1BBM	Fig. 293 1BBM	Fig. 293 1BBM	A Non-Return Valves
B Gate	Fig. 651 1BBM	Fig. 204 1BBM	Fig. 204 1BBM	B Header Valves
C Globe	Fig. 106-A Bronze	Fig. 950 Bronze	Fig. 1150 Bronze	C Drain Valves
D* Gate	Fig. 368 Bronze	Fig. 282 Bronze	Fig. 282 Bronze	D Water Column Valves
E Globe Lift Check	Fig. 106-A Bronze Fig. 117-A Bronze	Fig. 1150 Bronze Fig. 263 Bronze	Fig. 970 Bronze Fig. 263 Bronze	E Boiler Feed Valves
F Globe	Fig. 950 Bronze	Fig. 950 Bronze	Fig. 970 Bronze	F Soot Blower Valves
G Y or Blow-Off	Fig. 296 1BBM	Fig. 336 1BBM	Fig. 282 (Gate) Bronze	G Blow-Off Valves
H Globe Swing Check	Fig. 106-A Bronze Fig. 352 Bronze	Fig. 950 Bronze Fig. 762 Bronze	Fig. 970 Bronze Fig. 962 Bronze	H Auxiliary Equip. Valves
I Globe	Fig. 141 1BBM	Fig. 162-A 1BBM	Fig. 162-A 1BBM	I Engine Valves
J Globe	Fig. 106-A Bronze	Fig. 1150 Bronze	Fig. 970 Bronze	J Water Column Drain Valves
K Swing Check	Fig. 92 Bronze	Fig. 962 Bronze	Fig. 962 Bronze	K Boiler Feed Check Valves

*ASME BOILER CODE specifies that "when shut-off Valves are used on connection to a water column, they must be OS&Y Gate Valves and must be locked or sealed open".

JENKINS Bronze, Iron, Steel Valves to meet every need

A glance through the Jenkins Catalog shows that you can specify "Jenkins" for practically every phase of commercial, industrial, engineering and plumbing and heating needs. The line of over 600 valves includes:

Iron, Bronze, Cast Steel and Corrosion-resisting-alloy Gate, Globe, Angle, Cross, Y and Check valves... with composition, bronze, nickel alloy, iron and steel disc or plug... in solid wedge, split wedge, double disc-parallel seat and double disc-taper seat types... in inside screw and OS&Y patterns... with non-rising, traveling, rising and sliding spindle... conventional, quick-opening and rapid action... with screw-in, screw-over, union and bolted bonnet... with screw, flanged, union and solder ends... to meet Underwriters', AWWA, ASME and Marine specifications... in sizes ⅛" to 36"... for pressures from 125 to 600 pounds... for steam, air, oil, water, gas, chemicals, solvents and other fluids.

All are made to the standard of quality which has given Jenkins Valves the reputation of being "cheaper in the long run". Yet, with two exceptions, they cost no more to buy than other good valves.

AVAILABLE THROUGH GOOD SUPPLY HOUSES EVERYWHERE

#38
OF A SERIES
designed to help in selecting
JENKINS VALVES

JENKINS BROS., 80 White St., New York, N. Y.; Bridgeport, Boston, Atlanta, Philadelphia, Chicago, Houston. Jenkins Bros., Limited, Montreal, Canada; London, England.

REG U.S. PAT. OFF. TRADE JENKINS MARK
Jenkins Bros

ed Built Better but PRICED NO HIGHER

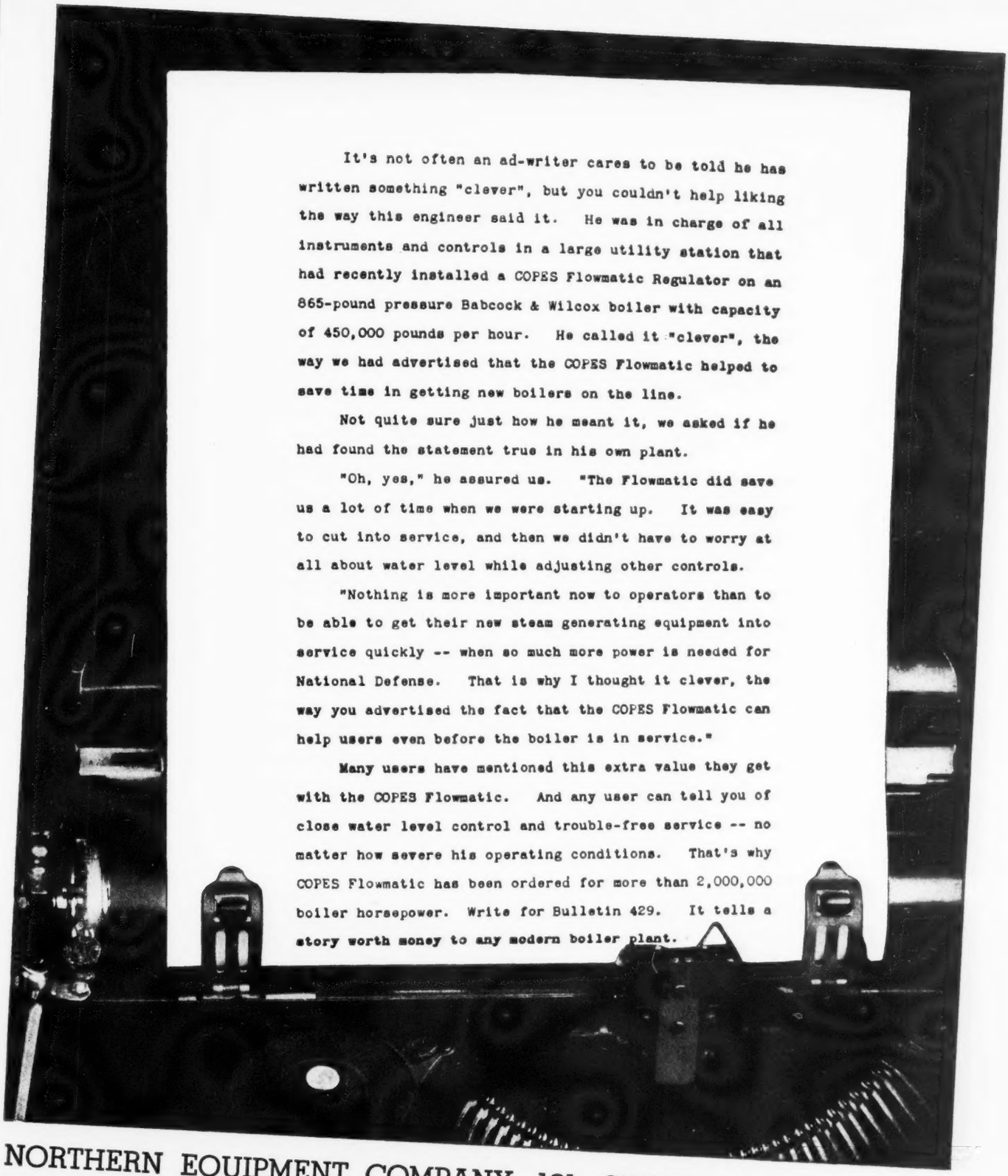
Number 113

More Steam From the Boiler!

How to Increase Boiler Capacity	*Precautions*
Raise the feedwater temperature by existing or new feedwater heaters.	Don't exceed temperature and pressure rating of feedwater heaters, and temperature ratings of feed pumps.
Raise the feedwater temperature by an economizer.	Don't lower the flue-gas temperature below the dew point or corrosion will result.
Change type of fuel; viz, coal to oil or gas.	Be sure of a dependable supply. Check suitability of combustion-chamber design.
Change method of firing; viz, hand fired to stoker fired, or from stoker to pulverized coal.	Be sure of availability of vital replacement parts. Check suitability of combustion-chamber design.
Increase firing rate.	Don't carry the unit heat release in combustion to excess. Guard against local overheating of boiler, flame impingement, and overheating of supporting structure. Exercise slag control.
Maintain clean internal surfaces in the boiler.	Scale or oil has no place in a boiler. Keep oil out and treat water under direction of a reputable laboratory.
Maintain proper boiler water level.	Erratic control means loss of capacity. A good feedwater regulator often pays dividends.
Save all waste heat in drips from heaters, exchangers, traps, separators, etc.	Use an indirect heat exchanger when the drips contain oil or are otherwise contaminated.
Test and maintain proper boiler-water concentration limits.	High concentration may mean scale and a reduction in limit of safe capacity.
Schedule the blowdowns to meet conditions.	Never blow down a boiler operating at high ratings, except as a last resort in emergency. Reduce the rating first.
Investigate possibilities of automatic combustion control.	Automatic control smooths out combustion peaks. Usually it increases gross capacity.
Have a full complement of instruments.	Flow meters and meters to guide combustion are essential for safe high-capacity operation.
Increase the operating pressure.	Be careful with this one! The boiler *must not* be operated at a higher pressure than allowed by the stamping, construction, certificate and condition as determined by an authorized inspector. Consider too, all piping, appliances, auxiliaries and prime movers using steam.
Eliminate all leaks.	Stop leaks by safe repair methods. Don't use make-shift ideas or procedure where safety is questionable.
Be sure all lines and exposed parts of the boiler are properly insulated.	Don't cover the standard stamping on the boiler, or close in parts necessary for access such as hand holes or washout plugs.
Keep heating surfaces clean by blowing soot and cleaning slag regularly.	Avoid furnace explosions when blowing soot in boilers with fuels burned in suspension. Blow soot during full loads and high CO_2 when there will be little free oxygen to support an explosion.
Keep gas baffles in good repair.	Failure to do this not only lowers capacity, but may overheat part of the boiler.
Check setting for air infiltration.	A poor setting may not be weak in structure only, it may seriously affect proper combustion.
Keep on hand vital spare parts.	Gross capacity is increased by reducing outage periods. Long delays in securing boiler tubes may be avoided by having a supply of spare tubes.

Harry M Spring

© POWER



It's not often an ad-writer cares to be told he has written something "clever", but you couldn't help liking the way this engineer said it. He was in charge of all instruments and controls in a large utility station that had recently installed a COPES Flowmatic Regulator on an 865-pound pressure Babcock & Wilcox boiler with capacity of 450,000 pounds per hour. He called it "clever", the way we had advertised that the COPES Flowmatic helped to save time in getting new boilers on the line.

Not quite sure just how he meant it, we asked if he had found the statement true in his own plant.

"Oh, yes," he assured us. "The Flowmatic did save us a lot of time when we were starting up. It was easy to cut into service, and then we didn't have to worry at all about water level while adjusting other controls.

"Nothing is more important now to operators than to be able to get their new steam generating equipment into service quickly -- when so much more power is needed for National Defense. That is why I thought it clever, the way you advertised the fact that the COPES Flowmatic can help users even before the boiler is in service."

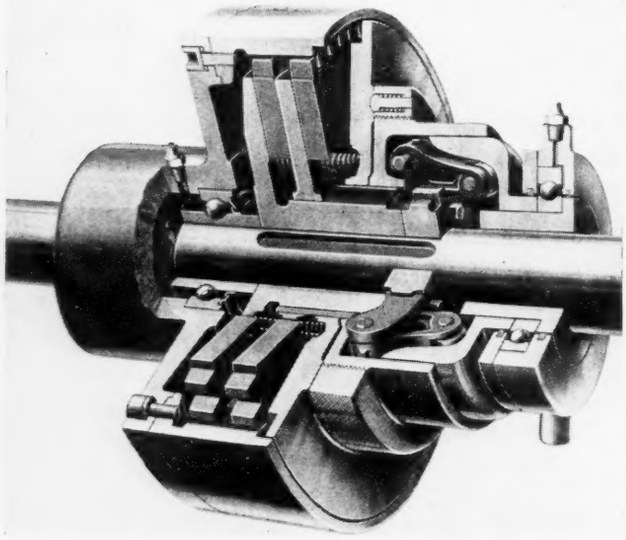
Many users have mentioned this extra value they get with the COPES Flowmatic. And any user can tell you of close water level control and trouble-free service -- no matter how severe his operating conditions. That's why COPES Flowmatic has been ordered for more than 2,000,000 boiler horsepower. Write for Bulletin 429. It tells a story worth money to any modern boiler plant.

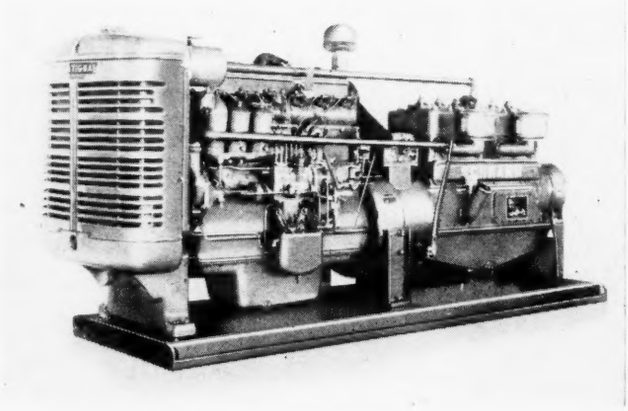
NORTHERN EQUIPMENT COMPANY, 121 GROVE DRIVE, ERIE, PA.

★ GET CLOSER LEVEL CONTROL WITH THE COPES FLOWMATIC ★ REGULATOR

FEEDS BOILER ACCORDING TO STEAM FLOW-AUTOMATICALLY

WHAT'S NEW IN PLANT EQUIPMENT





Friction Clutch

TORQUE-MASTER FRICTION CLUTCH is available in single- and multiple-disk types and in wide range of sizes. Designed for impact and pulsating loads. As indicated in illustration, friction plates are of gear-tooth design, while entire operating mechanism consists of only a few moving parts. All adjustments for wear or load conditions are made with one knurled hand adjusting ring. *T B Wood's Sons Co, Chambersburg, Pa.*

Drill

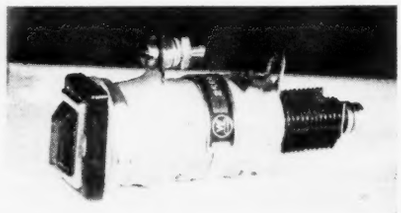
SKILLDRILL IS ¼-IN. UNIT for fast production drilling, weighs 2¾ lb, and fits in palm of operator's hand. Has no-load speed of 1800 rpm and full-load speed of 1050 rpm. Drilling capacity in steel is ¼ in. and in hardwood ½ in. *Skilsaw, Inc, 5030 Elston Ave, Chicago, Ill.*

Soldering Kit *(right)*

JIGGERS ARE SMALL, self-contained soldering units that contain correct amount of 50-50 solder and flux hermetically sealed in a waterproof heat-generating outshell. To obtain soldered electrical connection it is only necessary to push a wire splice into a jigger and touch a lighted match to it as shown. Shell ignites and produces proper temperature to flow solder into the splice. Burnt shell is then dropped *off. Jiggers, Inc, 215 W Illinois St, Chicago, Ill.*

Indicating Lamp

DESIGNED FOR GENERAL INDICATING OR signal purposes on switchboards, control desks and panel boards, new indicating lamp has rectangular-shaped lens designed for extreme angular visibility. Receptacle is made of 1-piece molded material and is suitable for



mounting on panels ☆ to 2 in. thick. Resistors as part of the unit are used for line voltage ratings between 50 and 250 volts. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

Pipe Insulator

CORROSION- AND LEAK-RESISTANT pipe insulator developed for cable systems which require insulation between cable sheaths or joint casings and oil-supply reservoirs connected to joints and terminals. Small annular channels provided in plastic portion of insulator. In these are molded gaskets of rubber. These gaskets form tight seal between plastic and brass of the inserts, thus preventing development of any leak because of differential expansion and contraction. *General Electric Co, Schenectady, N. Y.*

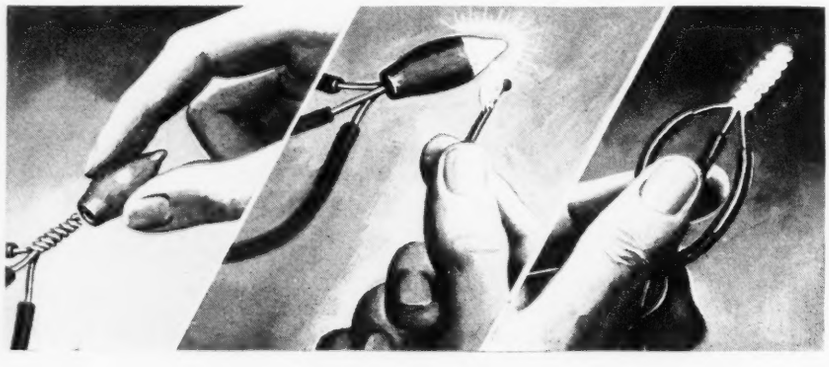
Compressor *(above)*

SCHRAMM "ENGINE DRIVE-IN-LINE" compressor built in sizes from 120 to 600 cu ft displacement, designed for applications not reached by electric power service or where gasoline, oil, diesel, etc, power units are preferred as driving medium. Mounted on sturdy deck-type base for immediate operation. *Schramm, Inc, West Chester, Pa.*

Controller

MODEL 30 STABILOG CONTROLLER appears in new universal rectangular case. Dual pressure indicator, replacing customary two small gages, is seen through rectangular opening in the door. All operating adjustments made

(*Continued on page* 136)



Ready Now!

TO HELP YOU AVOID PLANT INTERRUPTIONS . . .

CRANE SHOP BULLETIN NO. 4
TIPS ON VALVE TRIM
TO HELP KEEP PIPING ON THE JOB
PLEASE CHECK AND PASS ON
POST ON SHOP BULLETIN BOARD
IT'S THE TRIM THAT COUNTS!
DISC
STEM
BODY SEAT RINGS
AN AID TO DEFENSE . . . No. 4 of a series of Shop Bulletins on how to get better service from piping equipment in today's emergency. Issued for maintenance men by Crane Co.; distributed free by Crane Representatives.
HELPFUL HINTS ON CHOOSING VALVES FOR BETTER PIPING SERVICE
11 SIMPLE WAYS TO GET BETTER SERVICE FROM PIPING EQUIPMENT
HOW TO KEEP YOUR PLANT GOING WITHOUT INTERRUPTION!

UNDER wartime production burdens, the danger of piping failures is greatly increased. One way to stop them is by making sure valves are trimmed right for the service they're in. Crane Shop Bulletin No. 4, with its handy guide, shows the right trim for most valve applications in your plant.

Crane Shop Bulletins are aimed to give you better service from piping equipment—especially now when replacements aren't so plentiful. Prepared for your maintenance crews, they help train new workers as well as keep veterans "brushed up" on good piping practice.

Plants everywhere use these Bulletins in shops and employee training schools. In the hands of your men, they'll also help stop piping troubles and production line shutdowns.

Offered free to aid Defense, this timely Shop Bulletin Service may be had through your local Crane Representative. Call him today!

CRANE

CRANE CO., GENERAL OFFICES:
836 S. MICHIGAN AVENUE, CHICAGO

VALVES • FITTINGS • PIPE
PLUMBING • HEATING • PUMPS

NATION-WIDE SERVICE THROUGH BRANCHES AND WHOLESALERS IN ALL MARKETS

America Is at War . . .

America is at war. The time for discussion and debate is past. Regardless of personal preferences, we have but one objective now—to win this war as quickly as possible.

Fortunately for us, Americans have always fought to win. We had to. To wrest this great country from a primitive wilderness, to build and maintain upon its soil a civilization in which every man is his own master, to gain and hold our position as the world's greatest economic power, we have had to display, individually and as a nation, an indomitable courage, a basic energy, and a profound belief in the right of every fit individual to survive. We have fought for freedom, as men and as a nation.

For freedom is the *reason* for America. It was the reason for the Boston Tea Party, for the untold suffering at Valley Forge, for the bloody battles between the States, for the bold strokes which liberated Cuba and the Philippines. It is the beckoning light in Liberty's hand which has pulled Europe's enslaved millions to our shores. It is the right to live, to work, and to die as each man sees fit.

Here there can be no rulership by fiat, no distinction by birth, no prenatal assignment to locality, craft or creed. We, as individuals, are and will remain free to feed the furnaces of Pittsburgh, grow the corn of Iowa, or to teach the nation's youth.

America is at war. Let no thing, personal or otherwise, obscure that fact. If we must yield, for a little time, the things we hold dear in order to keep them always for our sons and our sons' sons, then let us yield them. If our essential democracy must for the time be submerged in order to keep for America its lasting place in the sun, then let us submerge it. To win, we must outproduce and outfight the cleverest, trickiest, and most ruthless of opponents.

We must fight fire with fire, to make certain, and this time for always, that the man with the club shall not have the right to rule the man without.

In the days ahead lie sacrifice. We who have always had so much must now do with little. We who have always worked as we pleased must now work without thought of reward or of surcease. Some of us must die, so that many of us may live. We must, each of us and all of us, do these things so that America may remain free, "that this nation, under God, shall have a new birth of freedom, and that government of the people, by the people, for the people, shall not perish from the earth."

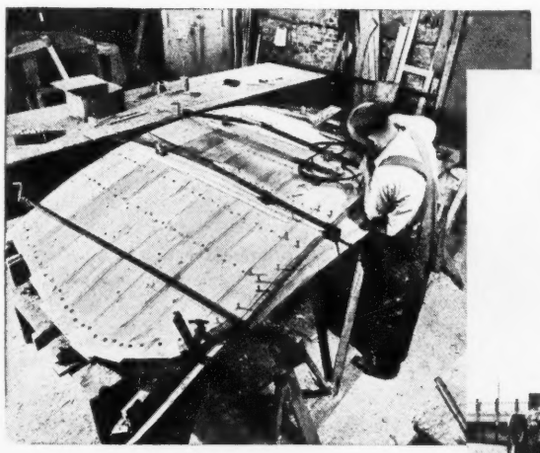
To that let us solemnly dedicate ourselves.

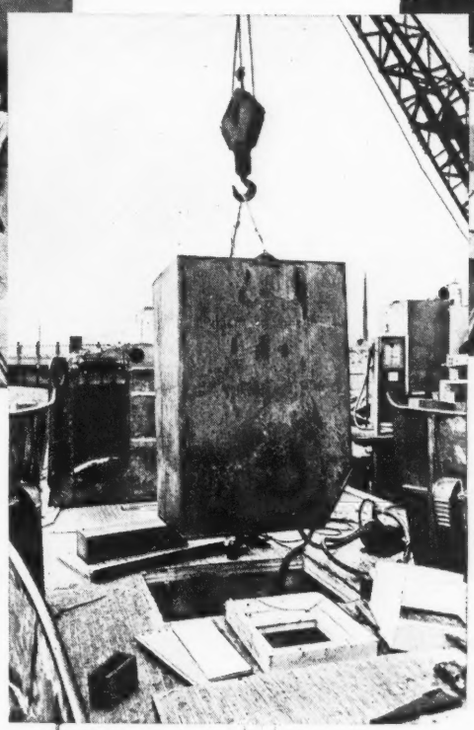
George Edwards

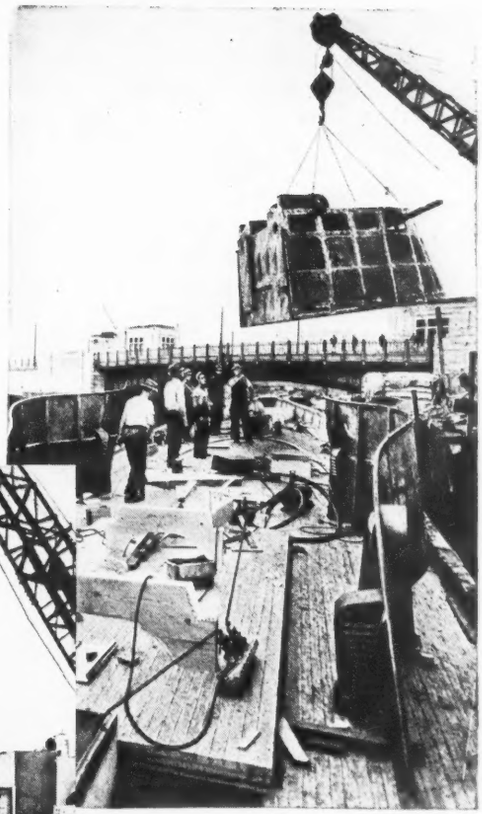
Engineer

Everdur ENLISTS!

See how this familiar Tank Metal is helping our total war effort in latest 83′ Coast Guard cutters







Above: **IT SHOULDN'T SURPRISE YOU** to find screws of Everdur going into the transom for this staunch 83-footer. Everdur screws also fasten all hull and deck planking. The finished cutter below is but one of many being built not only by Wheeler Shipyards, but also by other leaders in the industry that normally serves America's pleasure-boat market.

Above: **LOWER AWAY!** And into position swings a welded Everdur pilot house—made by the Gerstein & Cooper Co., South Boston, Mass. The wings already standing in position are also constructed of Everdur. Here's why: because EVERDUR Metal combines strength, *plus* corrosion-resistance, *plus* weldability, PLUS non-magnetic properties.

At left: **DOWN THE HATCH** goes the copper-silicon gasoline tank, also made by the Gerstein & Cooper Co. These tanks are made of this unique alloy for the same reason that Everdur has been so widely accepted as the ideal non-rust material for hot water storage tanks.

ANACONDA
from mine to consumer

Everdur COPPER-SILICON *Metal*

THE AMERICAN BRASS COMPANY, General Offices: Waterbury, Conn.

Subsidiary of Anaconda Copper Mining Company

In Canada: Anaconda American Brass Limited, New Toronto, Ontario

EVERDUR is a trademark of The American Brass Company, registered in the United States Patent Office.

OUR WAR NEEDS EVERDUR— And lots of it! Not just for 83-foot Coast Guards, but for many other types of craft, for fuel, oil and hydraulic pressure lines on airplanes, for elevator and control apparatus on gun mounts, for tanks and pressure vessels of many kinds in our war-vital chemical industries. Yes, Everdur, today, is a *precious* metal.

41184A

Here's why we say for '42

NOW, at the beginning of a new year in which the conservation of metals will be of the utmost importance for National Defense, we repeat something that we have been saying for many years: *Dart Unions pay greater dividends on your investment because they can be re-installed again, again and again.*

We suggest, therefore, that if there are any used Darts in storerooms or anywhere else around your plant, they be put back on the job. *They are still good . . .* and capable of the same tightness they provided the first time they were used.

How is this possible? Look at the illustration above. It shows the two famous Dart extra-wide bronze matched seats, ground to true-ball surfaces, a key reason for a Dart's unusual performance and long life. *Another* important reason is the fact that Dart bodies and nuts are made of air refined malleable iron that resists pipe strains, abuse, rust.

So—in behalf of metal conservation—*on* with the old Dart Unions. If you need *new* ones, get in touch with your local supplier. It always pays to remember, "Dart Unions can be used again, again, and again."

DART UNIONS

E. M. DART MFG. CO., Providence, R. I.

Argument Corner

(*Continued from page* 113)

during the welding operation tends to loosen the tubes, and thus to require doing at least a part of the work a second time. With the tubes in position before the welding operation, there is also the possibility of one or more being damaged by the torch below the seam line, and this unseen damage later resulting in failure. The thorough cleaning recommended by Mr. Wiggins is much more easily accomplished if the welding is done first and the spatter cleaned up before the operating space is complicated by the tubes.

There is one precaution which should be observed when making a repair of the nature discussed. If the upper head is so badly damaged as to demand replacement, the chances are that there will be serious reduction in cross-sectional area in the curved portion of the old head and also in the shell plate close to the junction of the two. It is not sufficient, nor is it safe, to assume good metal all the way to the rivet circle, just because it may show up well at the bevelled face for the new weld.

Incidentally, while on the subject, it might be well to remind the engineer to check the welder carefully to see that he runs the weld in a number of sections. A weld made by beginning at one point and continuing around the circle carries ahead of it a wave of distortion which is cumulative and which may result in a serious local stress when the weld is completed. Segmental welding, with short sections run out from a number of tack points and eventually joined, will give more even distribution of stress from new head to old ring than obtained if the line of least resistance in welding technique is followed and the bead run solid from one point.

Houston, Texas ELTON STERRETT

New Plant Equipment

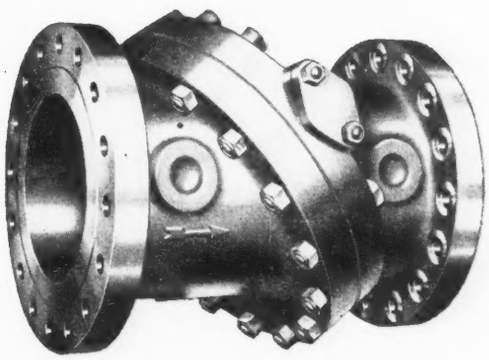
(*Continued from page* 132)

from case front, adjusting mechanisms for change of control point, throttling range and reset resistance being immediately accessible when door is opened. Unit construction simplifies replacement of measuring system and other parts if necessary. *Foxboro Co, Foxboro, Mass.*

IN POWER PLANTS - COAST TO COAST

Chapman

TILTING DISC CHECK VALVES



OUTSTANDING ADVANTAGES

Non-slam—cushioned closing.

Aerofoil disc rides the flow without flutter—reducing wear and replacement of moving parts.

Less resistance to flow—saves power, increases line capacity.

Closes drop-tight—stays tight.

Equally efficient when installed horizontally or vertically.

Made in iron, steel or alloy best suited to requirements, and for pressures to 1500 lbs.

A *crash stop* in an automobile, airplane, gun recoil or pipe line is bad business, and usually spells destruction or expensive repairs. The checking action in Chapman Tilting Disc Check Valves is positive and quick, but perfectly cushioned. There is no "slam" to strain the line or open up joints. They have many other important advantages over standard swing-type checks, and are setting new records for efficiency and low cost of maintenance in power applications.

THE CHAPMAN VALVE

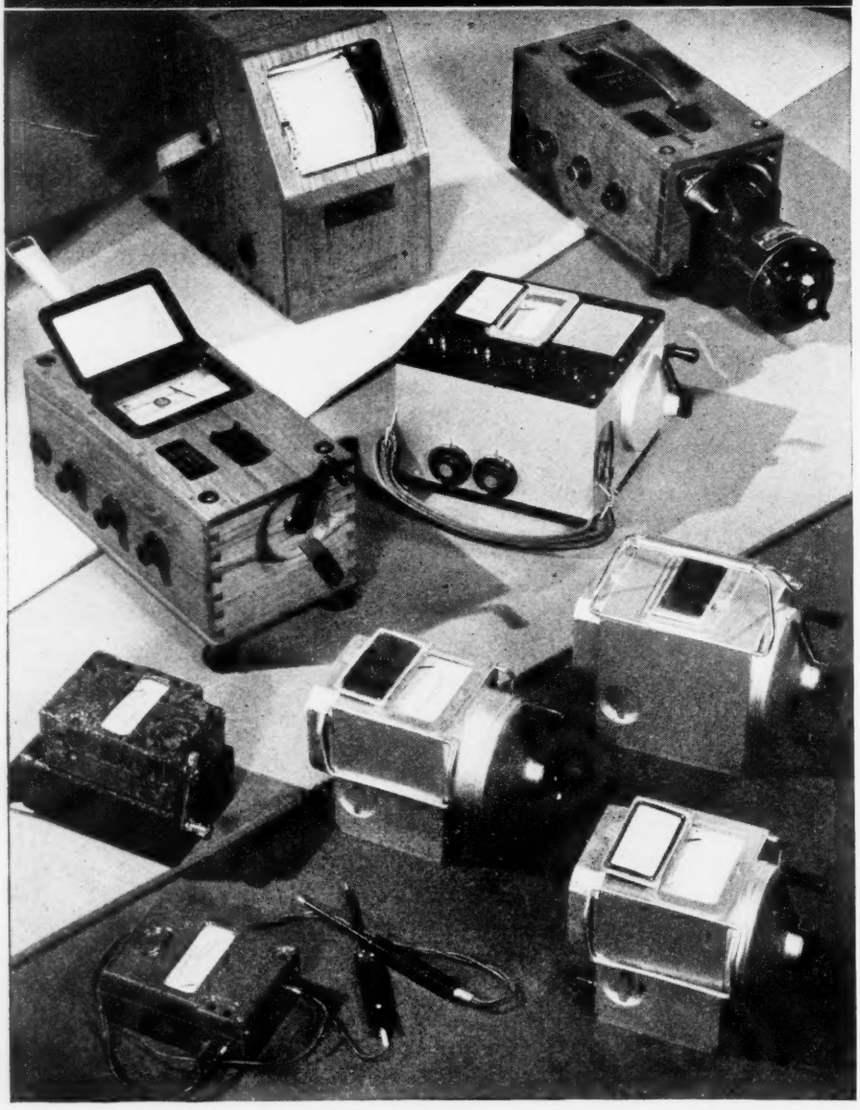
MANUFACTURING COMPANY

INDIAN ORCHARD, MASS.

"MEGGER"

TRADE MARK REGISTERED U.S.PAT OFF

Insulation Testers, Ground Testers and Ohmmeters



Today's Events

are emphasizing the importance and the dependability of these world-famous testing instruments, for detecting and preventing trouble in electrical equipment.

Do you have full information on how to operate and use them?

Write for . . . (no charge)—

Pocket Manual of "Megger" Practice.....No. 1420-P

Technical Bulletin on Ground Testing.....No. 1285-P

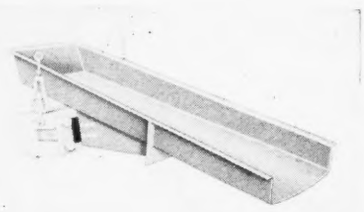
"Ducter" Ohmmeter (for quick measurements of very low resistance).....Bulletin 1635-P

James G. Biddle Co.

1211-13 ARCH STREET *Electrical and Scientific Instruments* PHILADELPHIA, PA.

Vibratory Feeders

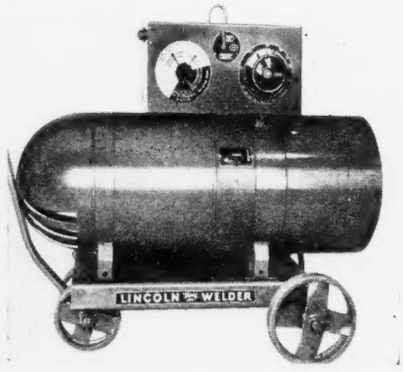
SYNTRON VIBRATORY FEEDERS announced in larger sizes. New models, F-4 and F-5, have capacities of 100 and 500 tons per hour, respectively. Model F-4,



illustrated, carries pans as wide as 36 in. and as long as 60 in. New models, like smaller-capacity units, are vibrated at high speed by pulsating electromagnet. *Syntron Co, 492 Lexington Ave, Homer City, Pa.*

Arc-Welder Control

IMPROVED AND SIMPLIFIED DESIGN of company's "dual continuous control" for arc-welding machines eliminates need for meters showing volts and amperes. Maker claims that this feature provides many possible combinations of voltage and current, due to fact that



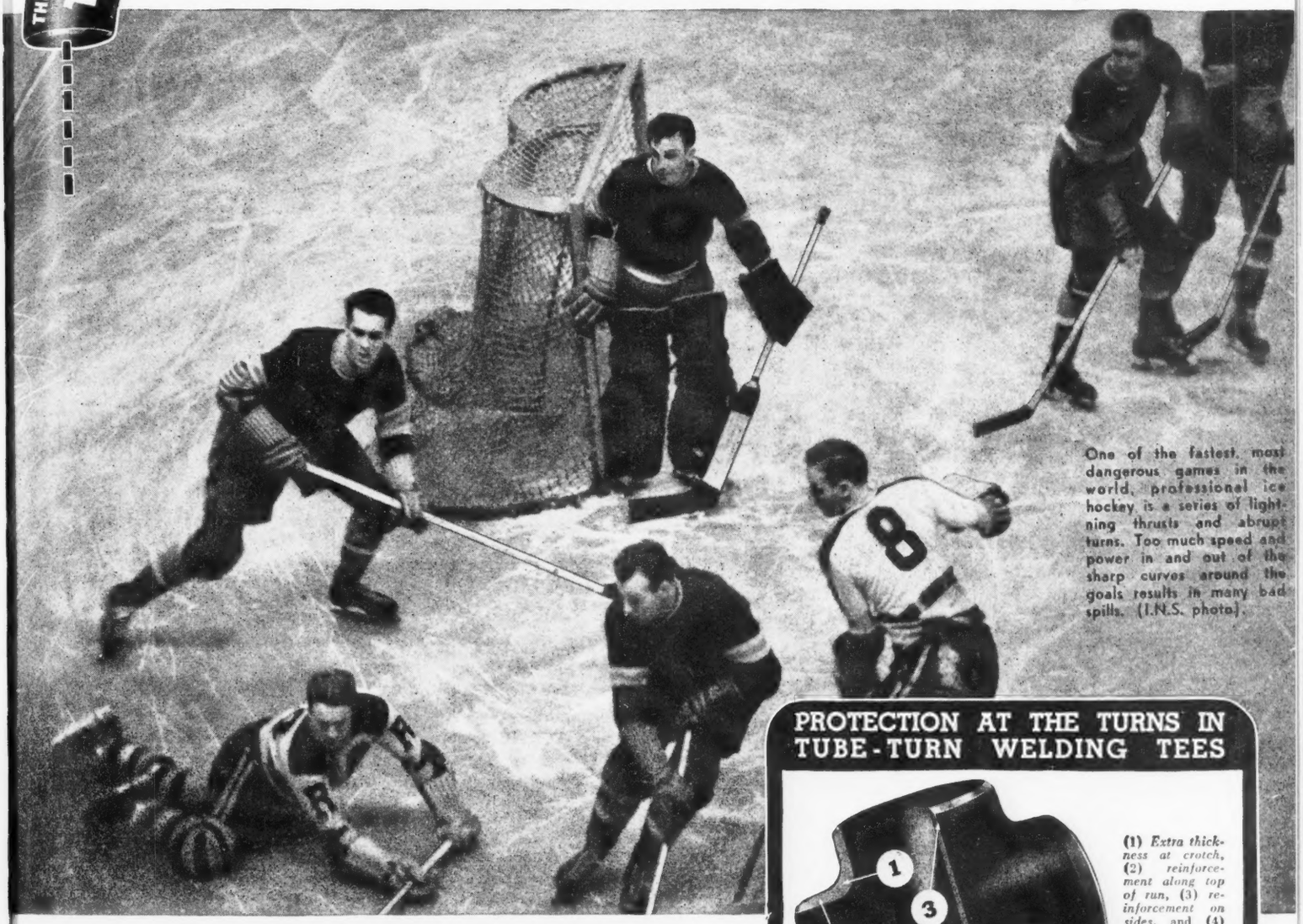
both voltage and current control are continuous in operation. Important advantage made available, according to maker, is ability to positively reverse polarity. Location of reversing switch has been changed to position formerly occupied by meter, immediately above and between self-indicating dials. *Lincoln Electric Co, 12818 Coit Rd, Cleveland, Ohio.*

Motor Control

THY-MO-TROL ELECTRONIC MOTOR CONTROL provides simple stepless control of dc motors from ac lines wherever wide speed range is desired. Normally consisting of three separate units, small control station, transformer and thyratron tube panel, control is said to be first to provide in one equipment means for electrically starting, stopping, accelerating and regulating mo-

THE DANGER LIES AT THE TURNS

LOOK OUT when force hits the turns in PIPING, too!



One of the fastest, most dangerous games in the world, professional ice hockey is a series of lightning thrusts and abrupt turns. Too much speed and power in and out of the sharp curves around the goals results in many bad spills. (I.N.S. photo).

Welding with TUBE-TURN Fittings removes "Danger at the Turns" in Piping!

Abrupt turns and surging speed—the very things that cause most accidents in hockey—also account for major piping troubles.

Wherever there's *a change in flow direction,* look out for extra wear and strain. Be sure of trouble-free operation with Tube-Turn Welding Fittings. They are designed and manufactured *expressly* to protect piping systems at these vulnerable points.

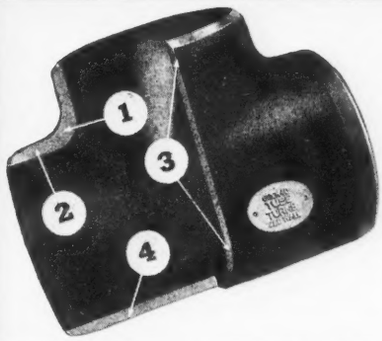
There are all types, sizes and weights of Tube-Turn welding fittings—elbows, returns, tees, reducers, laterals, nipples, and flanges. For *every* welding fitting need, specify Tube-Turn fittings *by name!*

Write for Tube-Turn engineering data book and catalog.

TUBE-TURNS, Inc., Louisville, Ky. *Branch offices:* New York, Philadelphia, Chicago, Pittsburgh, Cleveland, Tulsa, Los Angeles. *Distributors everywhere.*

TUBE-TURN *Welding Fittings*
TRADE-MARK

PROTECTION AT THE TURNS IN TUBE-TURN WELDING TEES



(1) *Extra thickness at crotch,* (2) *reinforcement along top of run,* (3) *reinforcement on sides,* and (4) *increased thickness at bottom* give extra strength to Tube-Turn tees at the points where stress and strain are greatest.

CROSS-SECTION OF TUBE-TURN ELBOW SHOWS SUPERIOR DESIGN

OUTER WALL NOT STRETCHED OR THINNED
SMOOTH INTERIOR WALLS NO WAVES OR RIDGES
SWEEPING RADIUS THROUGHOUT
MINIMUM RESISTANCE TO FLOW
INSIDE WALL NOT THICKENED
CLEAN ACCURATE BEVEL

Here are vital engineering advantages that tell quickly why you get more with Tube-Turn welding elbows—*the elbow that made ALL Tube-Turn fittings famous.*

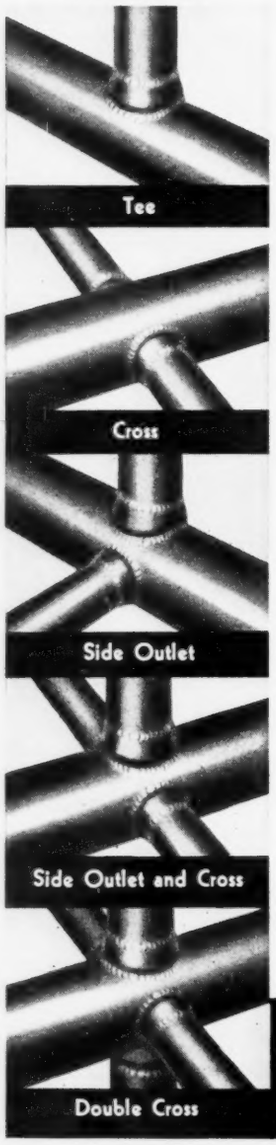
WELDOLETS·
TRADE MARKS - REG. U. S. PAT. OFF.
THREDOLETS
. . . Welded Outlets for Piping . . .

Any One or All 3 Will Make Any Right-Angle Welded Branch Pipe Outlet

WELDOLET

THREDOLET

SOCKET-END WELDOLET



TEES, Crosses, Side Outlets, Side Outlets and Crosses or Double Crosses—any one or all can be made with Bonney WeldOlets and ThredOlets.

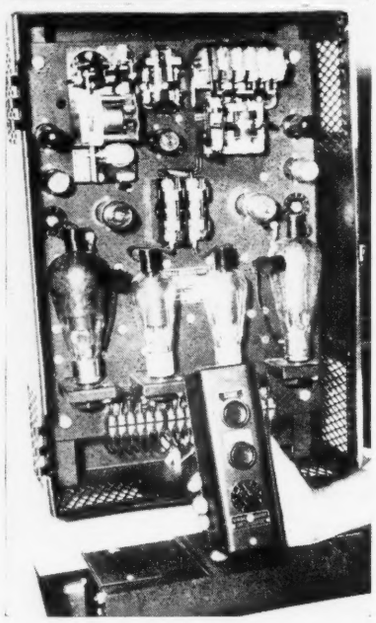
Every branch pipe outlet made with a WeldOlet, ThredOlet or Socket-End WeldOlet will provide a leak-proof junction of full pipe strength, that reduces friction and turbulence to a minimum.

No templets are required for cutting the hole in the main pipe—no complicated forming or fitting is necessary. The position of the outlet is selected and the WeldOlet or ThredOlet welded in place —the hole in the main pipe, in most cases, being made after the fitting is installed.

Bonney WeldOlets, ThredOlets and Socket-End WeldOlets are stock fittings of drop forged steel. To meet special conditions they can be supplied of Wrought Iron, Toncan Iron, Everdur, Monel, etc. They are adaptable to every type of piping system and for all commonly used pressures and temperatures.

You need a copy of Bulletin WT29, giving the complete story of WeldOlets and ThredOlets, in your files for reference on your next piping job. Write for your copy today.

BONNEY FORGE & TOOL WORKS
Forged Fittings Division - Allentown, Pa.
Forged by the Makers of
The Finest that Money Can Buy
BONNEY TOOLS



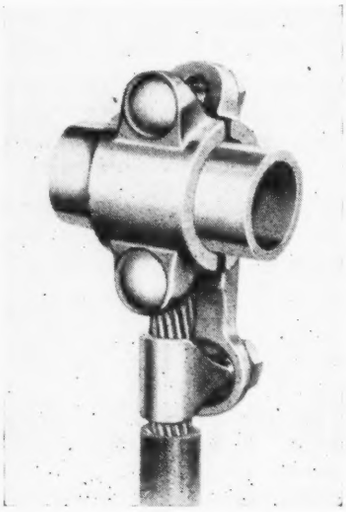
tor speed. Standard units will cover motor sizes up to 5 hp, 230 volts. *General Electric Co, Schenectady, N. Y.*

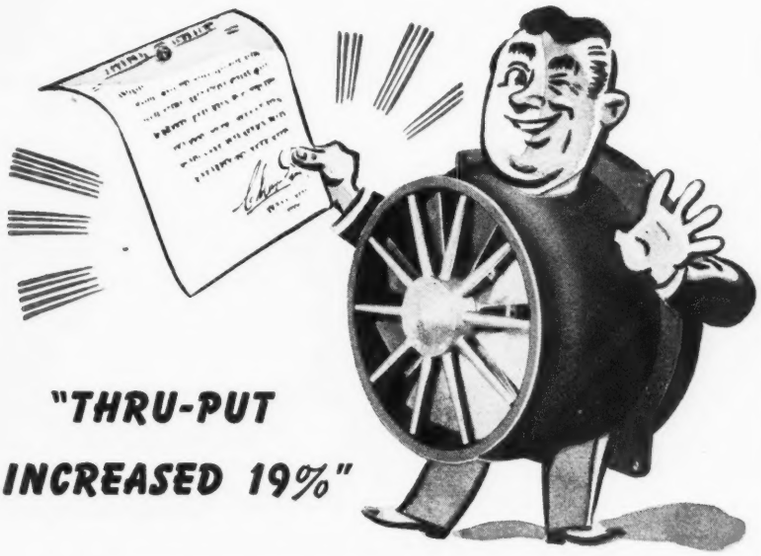
Bearing Metal

BABBITT METAL is for bearings subject to high pressures and temperatures. Known as Power Nickel Genuine Babbitt, this metal has tensile strength of 17,800 psi, a yield point of 6500 psi, Brinnell hardness of 27, and a pouring temperature from 950 to 1000 F. Nickel treatment gives metal a hard glossy surface, desirable for generators, motors and other high-speed applications. *Magnolia Metal Co, Dept 15, 120 Bayway, Elizabeth, N. J.*

Connector

BURNDY CONNECTOR, Type NVT, is all-clamp T-connector for tapping cable from tubing Flattened U-bolt on tap accommodates large range of cable





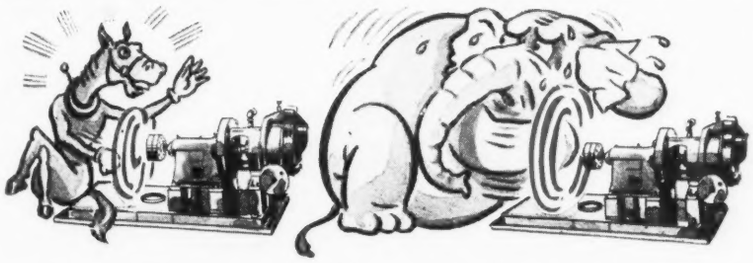
"THRU-PUT INCREASED 19%"

Perhaps there is an idea in this letter for getting more production out of *your* boilers, kilns, stills. The general manager of an oil refinery near Chicago (name furnished upon request) describes results obtained with Coppus-Dennis Fanmix Gas Burner:

"Furnace temperatures throughout are more even and savings in fuel most gratifying. We have no flame impingement whatever, and although our thru-put is much higher, we believe we have increased the life of our tubes in this heater by fully one-third."

Bulletin 410-3 will tell you about the perfect gas-air ratio and complete instantaneous combustion you get with Fanmix. Also describes famous Coppus "Blue Ribbon" design features. Check the coupon for a free copy.

COPPUS



A JOB FOR A SMALL STEAM TURBINE ... NOT EXPENSIVE ELEPHANT SIZE!

Fit the steam turbine to the job and save investment and maintenance cost. There are six frame sizes of Coppus Steam Turbines — with ratings from 150 HP down to fractional — and prices to match.

If it's a small-HP job, it's a Coppus job. And "Blue Ribbon" manufacturing (precision-built dynamometer-tested) means trouble-free performance. Check coupon for Bulletin 135-9.

COPPUS

COPPUS BLUE RIBBON PRODUCTS

DESIGNED FOR YOUR INDUSTRY...ENGINEERED FOR YOU

COPPUS ENGINEERING CORPORATION

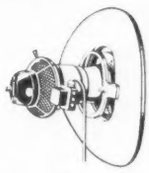
321 Park Avenue, Worcester, Mass.

Sales Offices in THOMAS' REGISTER. See SWEET'S for other "Blue Ribbon" Products.

You'll get valuable ideas from these free bulletins on other Coppus Blue Ribbon Products

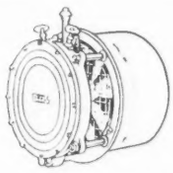
(Check the ones you want)

☐ Coppus Cable Manhole and Tank Ventilators. For confined working spaces. Bulletin 163-1.

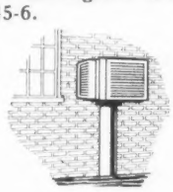


☐ Coppus Boiler Manhole Blowers and Exhausters. For cooling boilers, drums, etc. Bulletin 161-3.

☐ Coppus Heat Killers. Keep production up by keeping men cool. No stale air recirculation. Air is directed. Bulletin 160-5.



☐ Coppus Type C Turbo Blower. For undergrate draft. Bulletin 145-6.



☐ Coppus Air Filters. For engines and air compressors. Perfect, uninterrupted filtration. Bulletin F-310-4.

☐ Coppus-Dennis Fanmix Gas Burner (described in this ad).

☐ Coppus Steam Turbine (described in this ad).

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COMPANY .....

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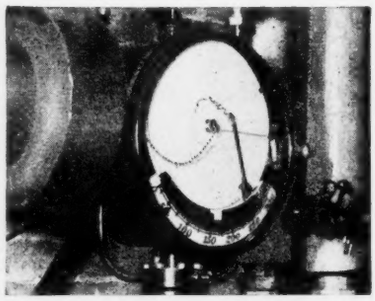
KEEP ACCURATE COSTS FOR STEAM, WATER, COMPRESSED AIR OR GAS

Get the data you need for allocating costs from these direct-reading, evenly-divided charts —recorded with exceptional accuracy at all rates of flow and TOTALIZED on the ADSCO Flow Meter.

Despite its high sensitivity to fluctuation in flow, the ADSCO Flow Meter is so simple and rugged that it cannot be damaged by sudden overloads or reverse flows—is easy to install and maintain.

Available with (1) recording chart, (2) indicating scale and (3) integrator counter to totalize the flow or other combinations thereof. Write us regarding your metering problems—also ask for Bulletin 35-83PR.



AMERICAN DISTRICT STEAM COMPANY NORTH TONAWANDA, N. Y.

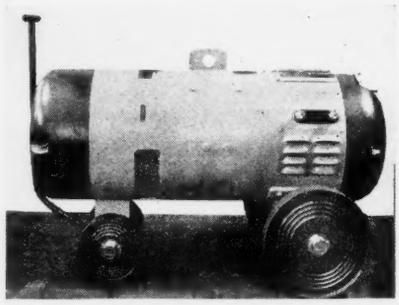
Making "UP-TO-DATE" Steam Line Equipment for over 60 years

LET ADSCO FLOW METER TELL YOU HOW MUCH . . . WHEN . . . WHERE

sizes. Large comprehensive range of U-bolt makes it suitable for clamping flexible and extra-flexible cables. *Burndy Engrg Co, 107 Eastern Blvd, New York, N. Y.*

DC Welder

FLEXARC PORTABLE WELDER rated at 200, 300 or 400 amp for 220, 440 and 550 volts ac circuit. Current adjustment is obtained by ball crank, making it possible to preset desired current before welding. Steady current regardless of arc length is provided by arc control which can be adjusted to suit welding job. *Westinghouse Electric & Mfg Co, East Pittsburgh, Pa.*

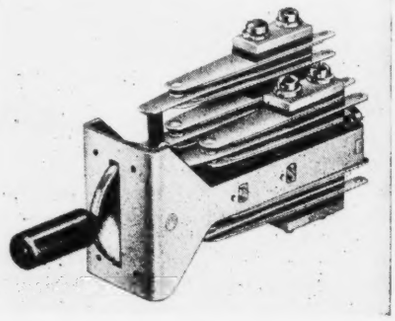


Power Units

KATOLIGHT UNITS now available in 7½ and 10 kw sizes at 1200 and 1800 rpm, and in 15-kw sizes at 1800 rpm. Models are available either self-excited or with separate exciter attached. Units driven by 4-cyl, 4-cycle engines, watercooled, with radiator fan and centrifugal pump, and including exhaust, muffler, governor with variable-speed control, pressure-lubrication system and other equipment. *Kato Engrg Co, Mankato, Mich.*

Lever Switch

SERIES 4101 LEVER SWITCH is heavy duty, multiple-contact unit, said to be first such switch to successfully provide positive action independent of contact springs. Design affords great flexibility, according to maker, of contact arrangements with either locking or non-locking action. Available in almost unlimited series of combinations of



F&E

THE EMBLEM OF QUALITY EQUIPMENT FOR

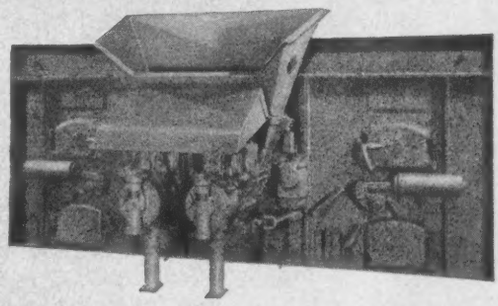
ONE HUNDRED YEARS

Since 1842, when James Flynn and Peter Emrich pioneered in steam generating and steam powered equipment and machinery, that partnership, which later became incorporated, has done more than keep pace with the progress of industry. For the Flynn and Emrich Company, as you know it today, is producing fuel-burning equipment that embodies advancements that will become accepted standards tomorrow.

As we enter our second century of service to *you*—the men in charge of America's power plants—it is fitting that the policy that has guided the Flynn and Emrich Company since its founding be reiterated—"BUILD THE BEST EQUIPMENT."

To the thousands of "F & E" customers scattered all over this great Nation, we extend our sincere appreciation for the confidence you have placed in "F & E" equipment—the kind of confidence that has helped "F & E" equipment acquire its enviable reputation for dependable, economical service.

Look to "F & E" for progress.

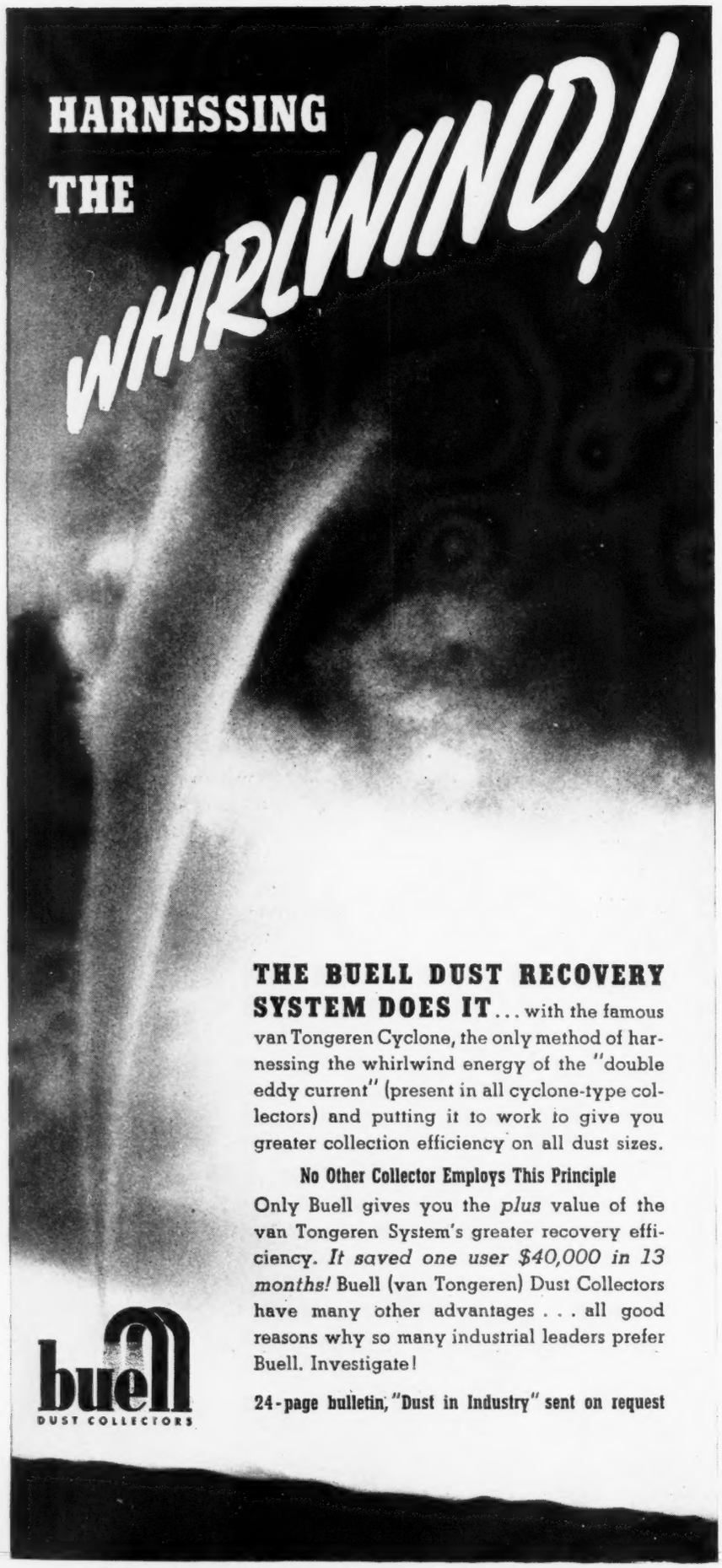


The Flynn & Emrich Co.

Established 1842 • Baltimore, Maryland

Manufacturers of Hydraulic and Steam Drive "F & E" Underfeed Stokers, "HUBER" Overfeed Stokers

Representatives in Principal Cities


HARNESSING
THE
WHIRLWIND!
THE BUELL DUST RECOVERY SYSTEM DOES IT... with the famous van Tongeren Cyclone, the only method of harnessing the whirlwind energy of the "double eddy current" (present in all cyclone-type collectors) and putting it to work to give you greater collection efficiency on all dust sizes.
No Other Collector Employs This Principle
Only Buell gives you the plus value of the van Tongeren System's greater recovery efficiency. It saved one user $40,000 in 13 months! Buell (van Tongeren) Dust Collectors have many other advantages . . . all good reasons why so many industrial leaders prefer Buell. Investigate!
24-page bulletin, "Dust in Industry" sent on request
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DUST COLLECTORS
BUELL ENGINEERING COMPANY, Inc. 10 Cedar Street, New York
NATION-WIDE SERVICE THROUGH OFFICES OF EITHER BUELL ENGINEERING CO. OR B. F. STURTEVANT CO.

contact assemblies, which can be built up to suit specifications. *Donald P Mossman, Inc, 6021 N Northwest Highway, Chicago, Ill.*

Belt Piler

PORTABLE PILER has rubber-tired wheels, and is designed for handling materials from boxcars, etc. Carrier can be raised and lowered by hand crank on side. Has safe maximum piling height of 8 ft, but will pile up to 10 ft. Provided with rough-top belting to minimize slipping. *National Conveyor Co, N St. Paul, Minn.*

Arc Welder

STRIKE-EASY, 150-AMP DC ARC WELDER announced for use in fabricating bright-surfaced, thin-gage metals. Has high instantaneous voltage recovery which helps operator strike arc with ease under difficulties presented by thin metals having bright polished surfaces. Rapid adjustment of welding current also provided by tap switch and rheostat. *General Electric Co, Schenectady, N. Y.*

Angle Meter

WOLFE ANGLE METER is practical "slide rule" for rapidly laying out angles directly on pipe or sheet metal. Using a method of measuring in both directions from a center line, it requires only four measurements to mark a pipe or stretch out in 16 different points on the circumference. *Interstate Sales Co, 1123 Broadway, New York, N. Y.*

Caliper

PISTOL-GRIP CALIPER said to be useful for calibrating tube ends after rolling, or checking for erosion and corrosion points. Calibration is effected by three points, and diameters from 2 to 6 in. can be secured with same tool by using different sets of measuring points. *Airtool Mfg Co, Springfield, Ohio.*

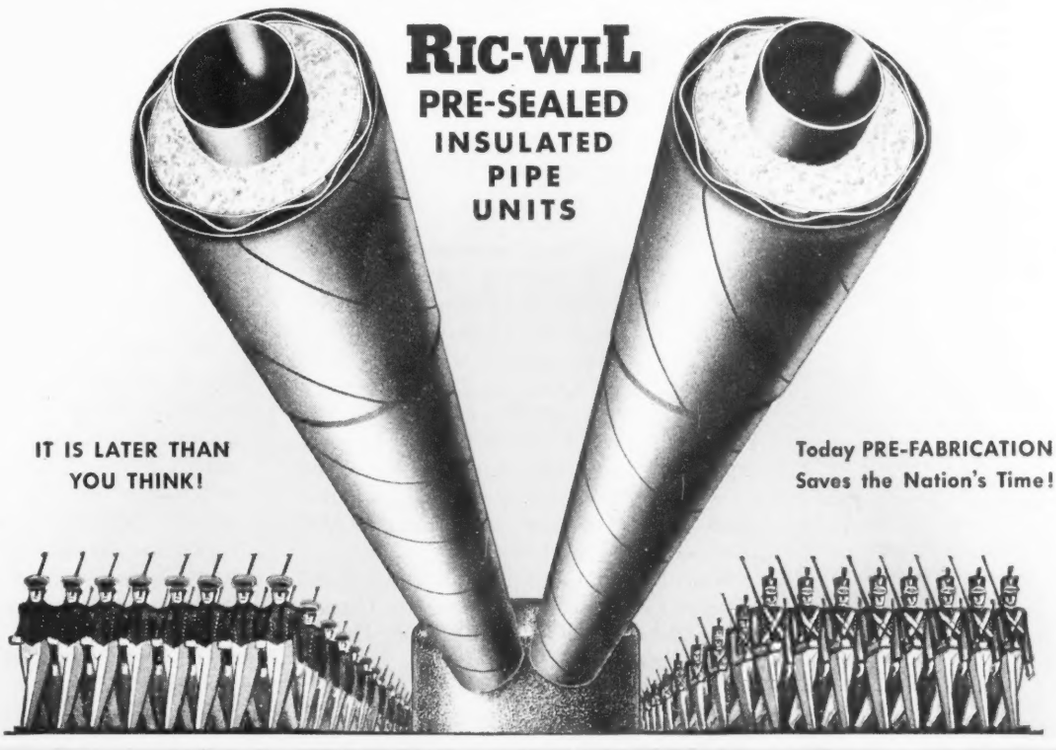
DEFENSE FOR AMERICA'S STEAM!

For 1942 RIC-WIL offers to all users of underground steam the most dependable conduit systems ever developed. Over half a million lineal feet of RIC-WIL Pre-sealed Insulated Pipe Units have recently been required for government or government-directed projects alone. Since 1910, nearly *one thousand miles* of RIC-WIL Systems of *all types* have been installed.

With ample engineering and fabricated resources, RIC-WIL was READY when the call came, to implement the life lines of steam on any front. RIC-WIL is exceptionally well equipped for fast and large-scale production of all the different types of underground protection we manufacture. Defense requirements naturally come first. During this emergency, however, you may be assured that we will do our best to supply also, just as rapidly as possible, all demands from private sources.

For assurance of the finest in underground steam protection, now as always, it pays to insist on RIC-WIL!

RIC-WIL Insulated Pipe Units are a factory-built system, delivered to the job complete per plans and specifications, ready for installation . . . Thoroughly engineered for maximum efficiency, long life and strength . . . RIC-WIL Tile or Cast Iron Systems likewise guarantee to the user the highest efficiency, durability, and service performance ever available in these types of construction. RIC-WIL's famous patented Dry-paC Waterproof Asbestos Insulation, as well as various standard commercial insulating materials, or sectional pipe covering, are to be had with any type of RIC-WIL design . . . Ask for complete information and latest RIC-WIL Catalog.



RIC-WIL

CONDUIT SYSTEMS FOR UNDERGROUND STEAM

THE RIC-WIL COMPANY • CLEVELAND, OHIO

AGENTS IN PRINCIPAL CITIES

HOW FERRISUL CAN HELP KEEP THIS SIGN OFF YOUR PLANT GATES!

THERE is even more at stake than costly repairs these days when you take a chance on untreated or improperly treated boiler feed water. You risk a power shut-down that may cripple your entire plant and add weeks to your production schedules.

That's why so many plant engineers are now relying on *Ferrisul* (anhydrous ferric sulfate) as a sure, safe, and easy way to rid boiler feed waters of silica and organic substances.

Ferrisul's floc is highly absorptive, forms immediately, settles rapidly, is stable over the entire pH range above 3.5, leaves no harmful coagulant residuals. Dry and free-flowing, Ferrisul is easy to handle and requires no expensive storage tanks. It can be transferred on any standard conveyor system, and introduced into the treatment in standard dry feed machines or solution feeders.

Write today for booklet which gives complete technical details. MONSANTO CHEMICAL COMPANY, Merrimac Division, Everett Station, Boston, Massachusetts.

FOR EXPERIENCED TECHNICAL ADVICE

Monsanto has an experienced staff of technical men handling Ferrisul in the field. They are in a position to give you sound, unbiased advice regarding the suitability of Ferrisul for your particular water problem.

LET'S GO! U.S.A. KEEP 'EM FLYING!

MONSANTO CHEMICALS
SERVING INDUSTRY ... WHICH SERVES MANKIND

Engineers' Books

(*Continued from page* 126)

ance and operating costs and correction of faulty operation. A section is devoted to relations with manufacturers, industrial-plant management, contractors, consultants and utilities to aid in the solution of mutual problems regarding electric service, equipment and use. Distribution or wiring systems are treated first with sections on switchboards, panelboards, transformers, etc. Special features of protection and control that apply only to certain classes of equipment are covered under that equipment. These are followed by sections on utilization equipment—motors, lighting, heat applications, welding, electroplating, electric trucks, storage batteries, signal and internal communication systems. Departmental functions like inspection, maintenance, testing, surveys, performance and cost analysis, power-factor and voltage correction are treated in separate sections. Throughout the work close attention has been given to application of the National Electrical Code, which has been reproduced in sections at the places in the text where specific rules apply. The treatment is practical throughout and presented in an easily understood style to meet the need of engineers and contractors who are associated in any way with electric light and power systems.

Welding

WELDING AND ITS APPLICATION (1941). *By Boniface S Rossi, ME, Director of Welding Div, The Delehanty Institute. Published by McGraw-Hill Book Co, 330 W 42nd St, New York, N. Y. 327 pages, 6x9 in., illustrated, cloth cover. Price $2.50.*

This book covers all the important phases of welding in a manner easy to understand. It will make a valuable addition to the reference library of designers, provide the experienced welder with a wider understanding of the welding process, and is a complete course in welding for the person wishing to study this art.

The author covers the different welding processes and their basic principles as well as the applications best suited for each. The text is profusely illustrated, adding to its value for the practical welder. One chapter is devoted exclusively to welding terms and their definitions and another covers the

2 YEARS WITHOUT AN OIL CHANGE

IN CIRCULATING SYSTEM

● EACH OIL CHANGE in the circulating system of the hydro-electric turbine in a Michigan plant required 70 gallons of oil. But the cost of oil was not the only reason the plant superintendent wanted to avoid frequent oil changes. Labor for cleaning the system was costly. Shutdowns were not only inconvenient, but expensive.

When a certain oil which he tried lasted only 6 weeks before it needed replacing, he welcomed the suggestion of a Standard Lubrication Engineer that he try a fill of Stanoil—an oil developed particularly for circulating system lubrication.

Now, after two years of operation in this system, Stanoil shows no sign of deterioration and little change in color. The saving in labor, oil costs, and shutdown time has *more* than paid for the difference in cost of this higher quality oil.

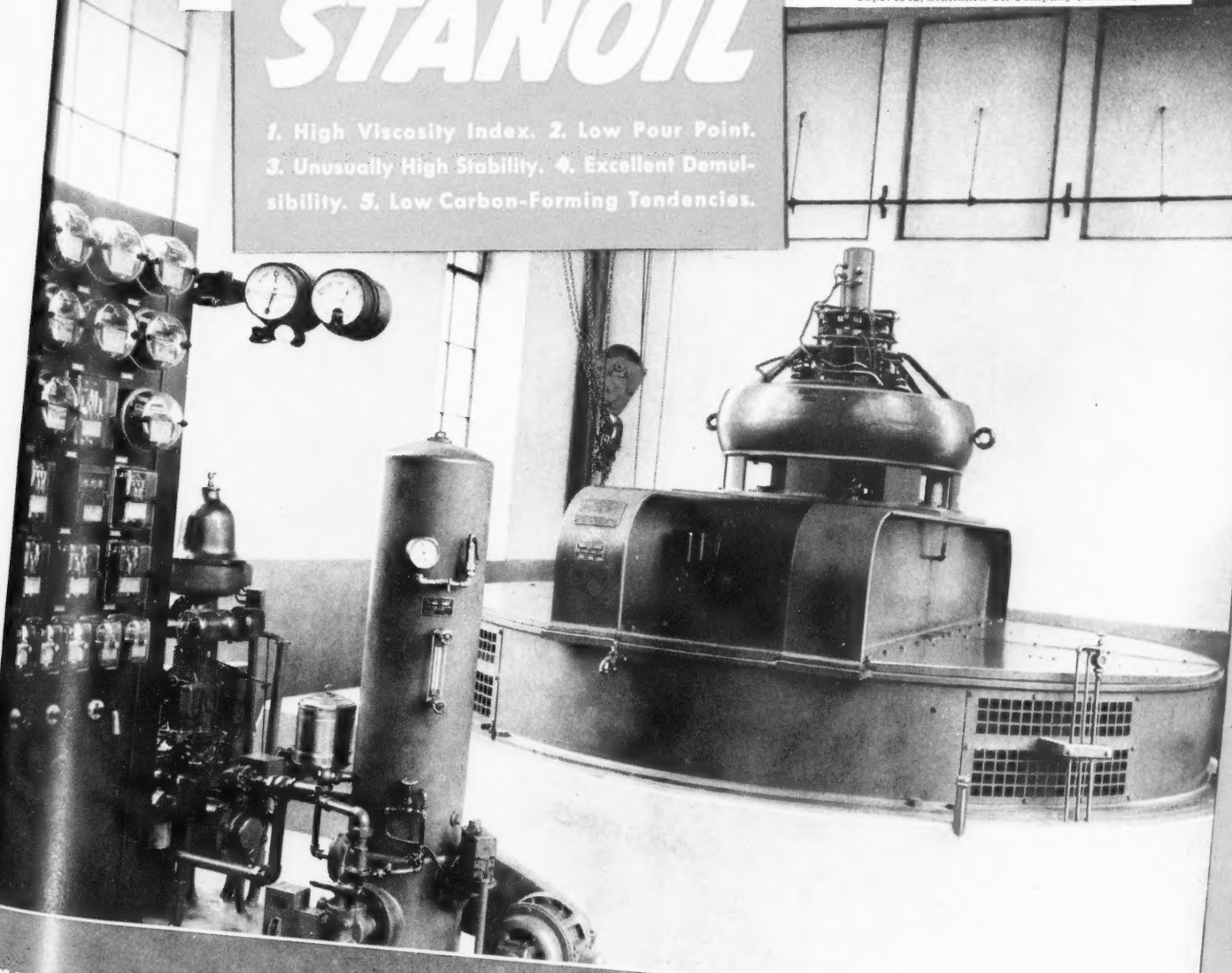
There are a number of grades of Stanoil. One of them may be just the oil you are looking for to save maintenance time and expense on reduction gear units, ring-oiled motor bearings, circulating systems, etc. A Standard Oil Engineer will tell you what grade you need for the job.

Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago, Illinois, for the Engineer nearest you. Say you want to try Stanoil.

Copr. 1942, Standard Oil Company (Indiana)

STANOIL

1. High Viscosity Index. 2. Low Pour Point. 3. Unusually High Stability. 4. Excellent Demulsibility. 5. Low Carbon-Forming Tendencies.



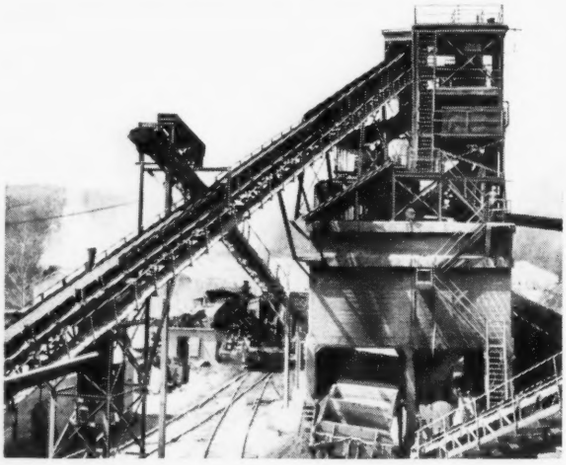
STANDARD OIL COMPANY (INDIANA)

LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION EN

..LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATION

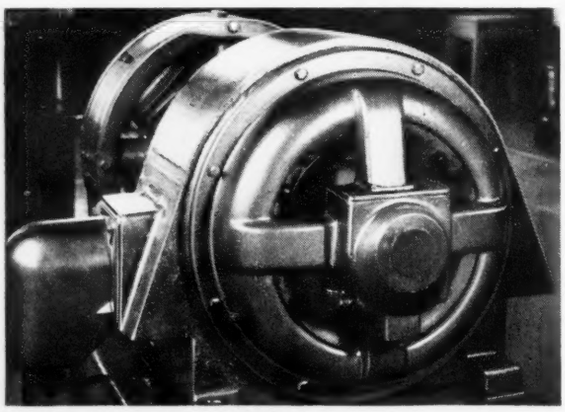
SUPERLA GREASE REDUCES LOAD ON CONVEYOR DRIVE

Two problems complicated the lubrication of material-handling conveyors pictured here. Greases light enough to reduce starting torque, even in mildly cold weather, were quickly consumed or lost when the idlers reached normal operating temperatures. Heavier greases made starting difficult and power consumption high. Medium grade conventional type greases did not solve the problem. Was there *any* lubricant that would do the job?



A Standard Lubrication Engineer had the answer—Superla Grease. At the first trial *both* starting and consumption problems were solved, because of Superla's uniform rate of feed at all temperatures encountered.

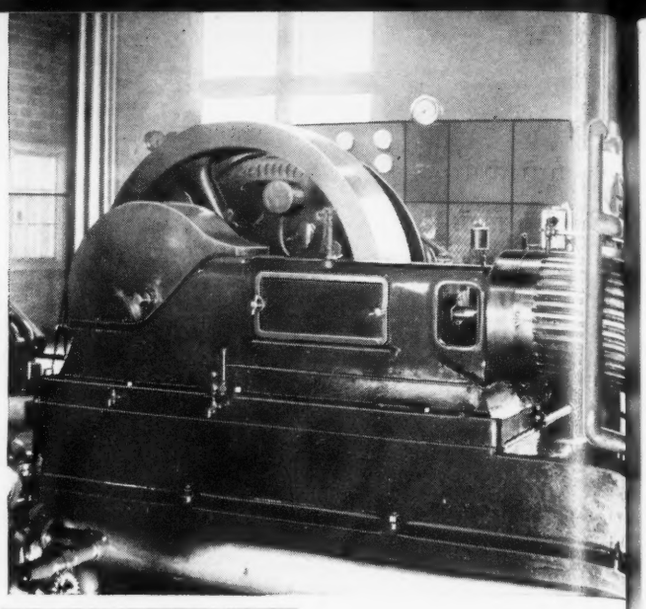
You'll find that Superla Grease will handle lubricating jobs for which you'd ordinarily buy a special premium-priced product. Have a Standard Engineer test Superla on some of your grease-lubricated bearings.



STANOIL PROTECTS GENERATOR BEARINGS AGAINST HEAT

Lack of space in an engine room made it necessary to mount a motor-generator on a balcony—the hottest spot in the room. The set operated continuously, which further increased bearing temperatures. To keep the bearings cool, the plant operator kept a fan blowing on the unit.

Then a Standard Lubrication Engineer told him about Stanoil. With Stanoil on the set the operator finds he can forget about both the fan and his bearing temperature troubles. Stanoil gives adequate lubrication even at high temperatures, because it does not thin out excessively.



STANDARD STEAM CYLINDER OILS ELIMINATE VALVE GROANING...CUT OIL CONSUMPTION 35%

Noisy slide valves in his two steam engines had the plant engineer at a Minnesota college worried. He knew that oil consumption on these engines was high enough to give more than adequate lubrication. He decided that it must be the fault of the oil he was using.

It didn't take long to find out he was right when he and a Standard Lubrication Engineer started analyzing his problem. First, they found that the oil wasn't atomizing properly. That trouble was cleared up when the right type of cylinder oil, which the Engineer recommended, was used. Valve groaning also disappeared. But the Engineer didn't stop there. He found that oil was being carried over into the heating system. So feeds were gradually reduced. Finally, consumption was cut 35%, yet the valves were adequately lubricated because of the high quality of the oil. Oil carryover thus was reduced to a minimum.

See if one of these Engineers hasn't a few suggestions that may be profitable to you.

HERE'S ALL YOU NEED TO DO TO GET STANDARD LUBRICATION ENGINEERING SERVICE

If your plant is located in the Middle West, you are free to call in the Standard Lubrication Engineer for advice and help on any lubricating problem. Right now, when your time is at a premium, is a good time to meet this Engineer. His suggestions may save a lot of experimenting and maintenance time where lubrication is concerned. You can reach him by calling the local Standard Oil Company (Indiana) office, or writing 910 South Michigan Avenue, Chicago, Illinois. In Nebraska, write the Standard Oil Company of Nebraska at Omaha.

COLORADO
Denver

ILLINOIS
Chicago
Decatur
Joliet
Peoria
Quincy

INDIANA
Evansville
Indianapolis
South Bend

IOWA
Davenport
Des Moines
Mason City

KANSAS
Wichita

MICHIGAN
Detroit
Grand Rapids
Saginaw

MINNESOTA
Duluth
Mankato
Minneapolis

MISSOURI
Kansas City
St. Louis
St. Joseph

MONTANA
Billings

NORTH DAKOTA
Fargo

SOUTH DAKOTA
Huron

WISCONSIN
Green Bay
La Crosse
Milwaukee

WYOMING
Cheyenne

6 YEARS' successful use of PHOSCALOID proves the value of PROTEIN ACID PHOSPHATE

A large New England Gas Plant, using raw make-up water finds boilers clean and free from scale, corrosion, and sludge every year since December, 1935 when this treatment was first started. Plant records on this follow—

Dec.-1936 . . . "Internal inspection showed very satisfactory."

March 29-1937 . . . "drums, tubes and nipples were found free of scale".

Feb. 28-1938 . . . after an internal inspection of a boiler by the operators, they agreed—"it was a 'honey' as the internal hosing alone left it perfectly clean".

Feb. 6-1939 . . . inspection of Nos. 1 and 4 boilers "found them with no appreciable depositions in tubes and drums"—"of course, we were very much pleased with the internal conditions of these boilers".

Jan. 25-1940 . . . "we recently examined one of the B. & W. boilers which had been in operation more than 240 boiler days"—"this boiler was in excellent condition".

March 8-1940 . . . "three other boilers were found to be as good as the first reported".

March 25-1941 . . . "the three drums were perfectly clean and free from any deposits or evidence of corrosion"—"the tubes being only coated lightly with liquid mud, which washed off to the bare metal".

Results of this kind with Phoscaloid are possible with any kind of water and at a cost that is surprisingly low. The combined sludge-removing and reaction value of the colloids in Phoscaloid are the responsible agents for these remarkable conditions.

BOOKLET AND MORE INFORMATION ON REQUEST

CYRUS WM. RICE & COMPANY

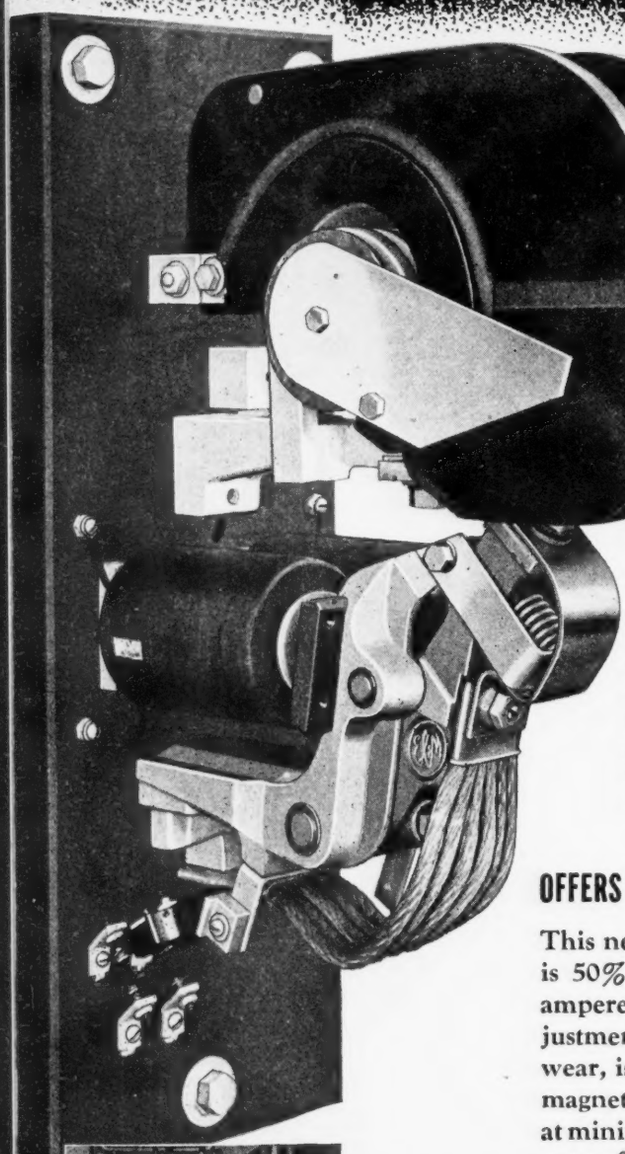
WATER CHEMISTS & ENGINEERS

PITTSBURGH

PENNA.

CWR

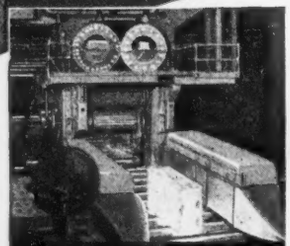
WORLD'S
FASTEST
600 AMPERE CONTACTOR
for D-C Service
TO HELP GET MORE Production



The faster response of this EC&M Contactor results in *greater accuracy* in spotting crane loads, fewer applications of down-power, reduced number of bridge and trolley motions—*faster positioning* of screwdowns, side-guards, manipulator fingers, etc. . . . briefly, *an aid to greater production in '42.*

OFFERS MANY OUTSTANDING FEATURES

This new EC&M Magnetic Contactor is 50% faster than the previous 600 ampere contactor, has a 2-position adjustment permitting over ½" contact-wear, is designed with highly efficient magnetic circuit, keeping leakage flux at minimum and inductance down, has powerful magnetic blow-out and large arc shield for highly inductive circuits, and *embodies LINE-ARC principle.*



A prominent steel company recently increased production by over 9,600 tons per month through modernization. Among the new equipment were EC&M Controllers for all auxiliary drives—tables, side-guards, screwdown, manipulators, etc., of this mill.

IT PAYS TO MODERNIZE

● Be sure to specify EC&M *Line-Arc* Contactor Control for d-c cranes and mill auxiliary drives.

THE ELECTRIC CONTROLLER & MFG. CO. CLEVELAND, OHIO

THE ELECTRIC CONTROLLER & MFG. CO.
CLEVELAND - - - OHIO

HEAVY DUTY MOTOR CONTROL FOR CRANES, MILL DRIVES AND MACHINERY • BRAKES • LIMIT STOPS • LIFTING MAGNETS AND AUTOMATIC WELD TIMERS.

weldability of various metals by arc welding. In welding, the metallurgical, chemical, physical and thermal characteristics of the metals greatly influence their weldability. These characteristics require special welding technique, proper heat treatment, correct electrode polarity and proper electrode. This subject is covered thoroughly and includes information on all metals and their alloys. Numerous diagrams are used to explain the laying of welding beads, correct movement of electrode holder and the preparation of metal edges for welding. The welding symbols used by American Welding Society are illustrated on actual layout diagrams and instructions for their use are given.

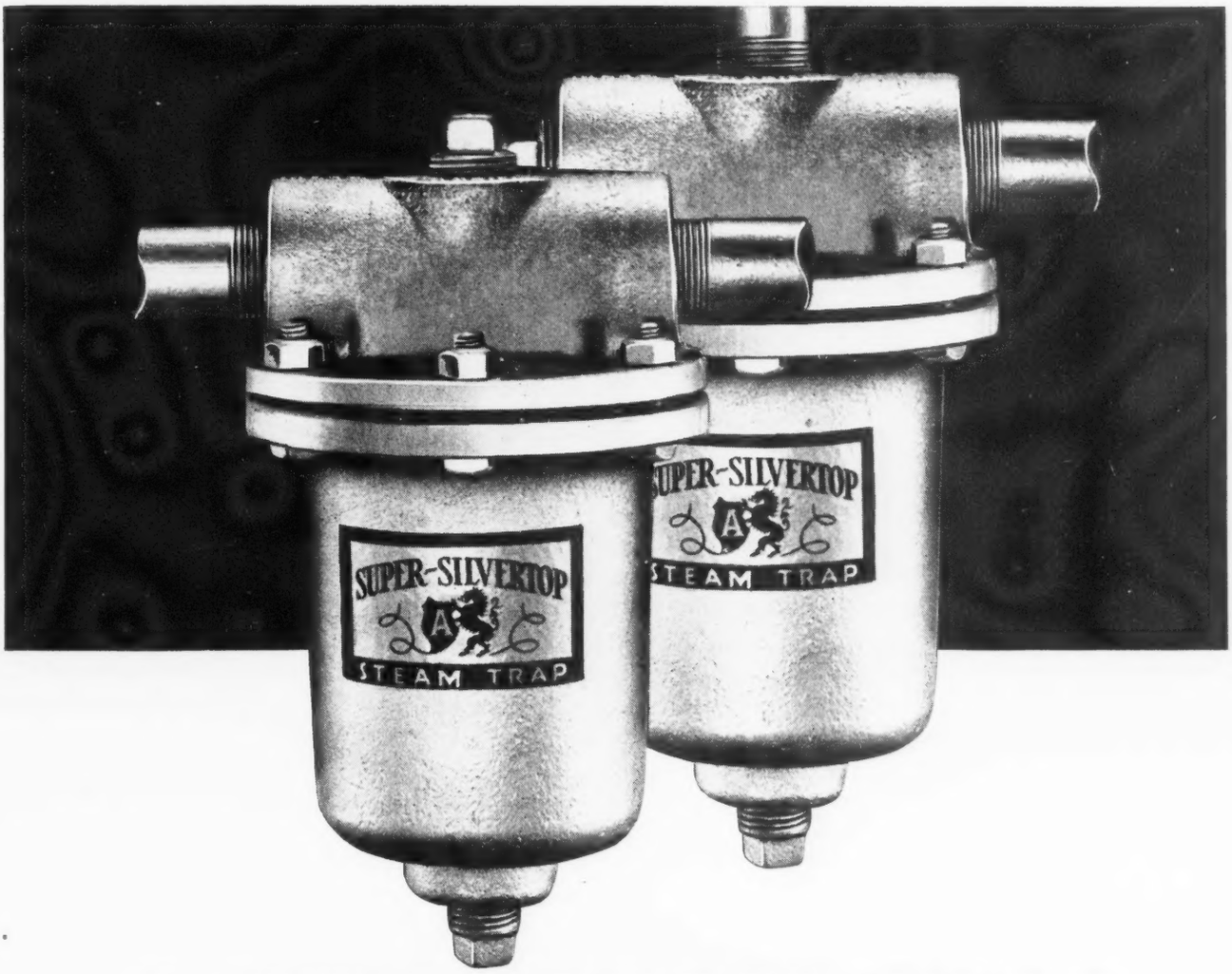
The section devoted to gas welding includes the technique of flame cutting. Adjustment of the gas-supply regulators is explained as well as the flame adjustment for both types of work. The author carefully explains the question of when to use an oxidizing flame in the gas welding and cutting process.

Automatic welding and cutting-machine practice is explained and discussed, as is also the testing and inspection of welds.

Safety

INDUSTRIAL ACCIDENT PREVENTION — *(Second Edition, 1941). By H. W. Heinrich, assistant superintendent, Engineering and Inspection Div, The Travelers Insurance Co. Published by McGraw-Hill Book Co, 330 W 42nd St, New York, N. Y. 448 pages, 5½ x 8 in.; 154 illustrations; 20 tables; cloth binding. Price* $3.00.

Because of the greatly accelerated tempo of industry to meet the national-defense effort, industrial and other accidents are on the increase, so much so that President Roosevelt recently called upon the National Safety Council for a concerted and intensified drive for greater safety. Coming at this time when employee lost time due to accidents presents a serious problem in the national-defense effort this book meets a real need. It has been revised and brought up to date according to experience gained since the first edition was published 10 years ago. The new edition is orderly and logical and is especially adapted to textbook purposes. It is directed to industrial executives, personnel managers, safety directors, safety inspectors and engineers, supervisors and foremen, and students of business management and insurance, as individuals and as instructors who are



2-WAY STEAM TRAP

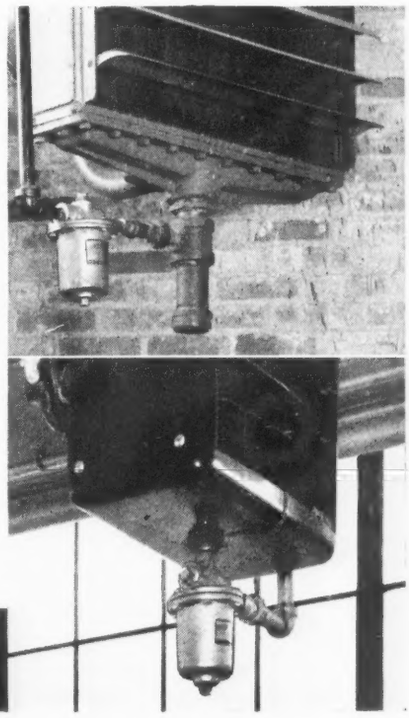
CONNECT IT STRAIGHT-IN-LINE OR AS AN ELBOW

You don't need two different traps to have a choice of connections—for Super-Silvertop is a "2-way steam trap" that connects either as an elbow *or* straight-in-line. If your drain pipe comes out of the bottom of a piece of equipment, use the elbow connection inlet at the top. If the drain is at the side of the equipment, use the side inlet of the trap and continue on in a straight line to the return line

Then too, Anderson Super-Silvertops are designed with a solid gasket and all passages are drilled—avoiding the risk of steam leaks through a split gasket or the possibility of clogging or restricted flow that might occur with cored passages. Positive valve closing is assured by the guided bucket, and trap is easily inspected without disturbing pipe connections

All these advantages are yours in a complete size and pressure range —from the small No. 19 up through the largest forged steel trap, so that every trap application gets full advantage of every Super-Silver top feature.

Get all the facts about Anderson Super-Silvertop, the 2-way steam trap, the long-life, trouble-free steam trap. Send for your copy of the helpful book "How To Choose A Steam Trap."



THE V. D. ANDERSON COMPANY
1934 W. 96th Street • • Cleveland, Ohio

Fully Insured Against Oil Failure.

Turbine oil has been known to serve for many years without changing and with very little care, then has failed from no apparent cause and with slight warning.

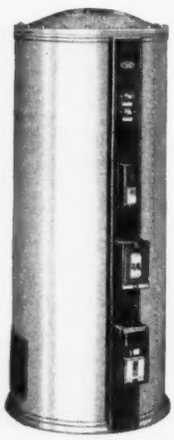
Any Steam Turbine or Hydro Electric Generator operating with a Honan-Crane Continuous Oil Purifier is using the best possible insurance against oil failures.

This oil purifier will remove *all* danger of any kind of oil contamination caused by *sludge, acid, steam emulsion, moisture* or *abrasives.*

Honan-Crane Continuous Oil Purifiers are
—DIRECT CONNECTED AND CONTINUOUS
NO MOVING PARTS • AUTOMATIC OPERATION
STREAMLINED DESIGN • FULLY INSULATED

The Honan-Crane Continuous Oil Purifier is backed by twenty years of research and experience and its performance is guaranteed.

HONAN-CRANE CORP. • LEBANON, INDIANA
Offices in Principal Cities



Write
for Bulletin 300TP for full information about purification of oil for Steam Turbines and Hydro Electric Generators.

ADVANCED IN ENGINEERING AND DESIGN

engaged in teaching classes of these individuals. The treatment is divided into 14 chapters; principles of accident prevention, creating and maintaining interest in safety, fact finding, corrective action, machine guarding, process and procedure revision, safety psychology, fatigue, occupational diseases, illumination, safety organization, accident statistics, and education of employees. Nine appendices cover other features of accident prevention.

Coal

KEYSTONE COAL BUYERS' MANUAL (1941) *Edited by Sydney A Hale. Published by the McGraw-Hill Publishing Co, Inc, 330 W 42nd Street, New York, N. Y. 448 pages, cloth bound, 7x10 in. Price* $10.00.

This is the 23rd edition completely revised. A handy reference book for coal buyers. It includes a directory of 2,639 coal mines located in the United States and Canada. These are listed alphabetically and geographically. More than 4000 Individual Mine Analysis, covering several sizes, for the majority of these mines located in the 15 most important coal producing states are given. Most of these analyses have been made by the United States Bureau of Mines and in every case can be accepted as a standard for true evaluation of the coal in question. Sources and dates when taken are shown. A directory of Coal Sales Organizations listed geographically showing main and branch offices. This directory includes distributors, sales agents and wholesalers. A number of articles on coal telling how to figure combustion, how to burn coal and how to buy it. These were extracted in part from an article called "Fuels and Combustion" published by POWER in its December, 1940 issue.

Instruments

INDUSTRIAL INSTRUMENTS FOR MEASUREMENT AND CONTROL (*First Edition*—1941). *By Thomas J. Rhodes, engineer, Proctor & Gamble Co. Published by McGraw-Hill Book Co, 330 W 42nd St, New York, N. Y. 573 pages, 6x9 in.; 283 illustrations; 26 tables; cloth binding. Price* $6.00.

Instrumentation and control are comparatively new and this probably accounts for the few books that we have on these subjects. Their importance, however, is evidenced by the extensive literature we have in other engineering

ADD CASH STANDARD AUTOMATIC COMBUSTION CONTROL

TO REALIZE AND MAINTAIN *Economical* BOILER ROOM OPERATION

WHETHER YOU BURN COAL, OIL or GAS

BECAUSE:

★ Bulletin No. 300 gives you full details on CASH STANDARD Automatic Combustion Control for steam plant economy and shows applications of these systems for coal, gas, or oil operated boiler rooms.

With CASH STANDARD Automatic Combustion Control you have at all times dependable adjustment of the rate of feed exactly to the load requirements — NO over-firing nor under-firing.

. . . YOU SAVE FUEL

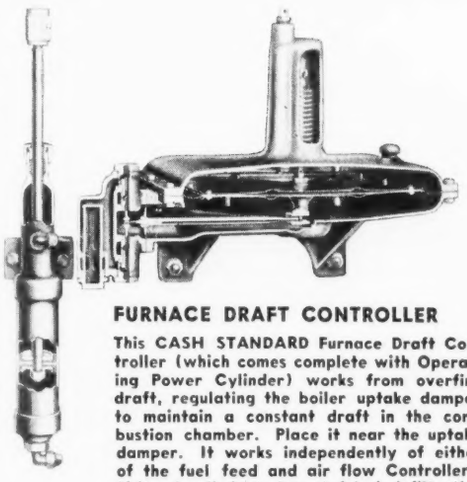
Correct proportions of air constantly maintained for you so that the amount of fuel which is being fed, at any time, is burned economically — you never experience too much or too little air supply.

. . . You Hold Steam Pressures to within very close limits

Proper operation of the stack damper is afforded by CASH STANDARD Controls so that you hold over-fire draft to minimum, preventing infiltration of outside air and undue stack loss.

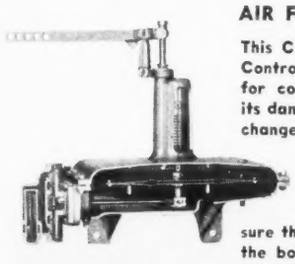
. . . YOU AVOID WASTE

The units shown here make up a complete CASH STANDARD system. Each unit is available in a number of variations to make up systems to meet different requirements. The Furnace Draft Controller installed separately to start you with CASH STANDARD Automatic Combustion Control, is but one part of the complete system. It gives you an opportunity to see for yourself how your fuel bill can be cut and how you get more steam.



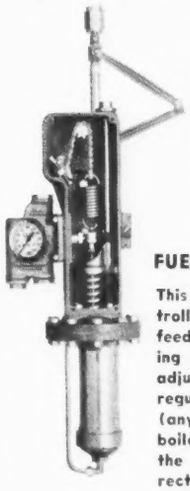
FURNACE DRAFT CONTROLLER

This CASH STANDARD Furnace Draft Controller (which comes complete with Operating Power Cylinder) works from overfire draft, regulating the boiler uptake damper to maintain a constant draft in the combustion chamber. Place it near the uptake damper. It works independently of either of the fuel feed and air flow Controllers. If it only eliminated wasteful air infiltration it would be a profitable investment.



AIR FLOW CONTROLLER

This CASH STANDARD Air Flow Controller meters the air needed for combustion. Install it near its damper. It is not affected by changes in fuel bed resistance or any other variables, because it meters air supply according to the differential pressure through the gas passages of the boiler, doing its part to insure perfect combustion.



FUEL FEED CONTROLLER

This CASH STANDARD Master Controller automatically regulates fuel feed. Locate it conveniently. Working from boiler pressure, it will adjust the rate of combustion by regulating the rate at which fuel (any kind of fuel) is supplied to the boiler furnace. And it will adjust the Air Flow Controller so the correct amount of air is supplied for proper combustion — hence, money saving.

OIL CIRCULATOR

The purchase of this oil circulator is optional. All three Controllers shown above can be properly operated by clean water, but it is preferable and cheapest in the long run to operate with this CASH STANDARD Oil Circulator equipped with 110-220 v. 60 cy. motor.

A. W. CASH COMPANY
DECATUR, ILLINOIS

CASH STANDARD
CONTROLS . . VALVES

"BAERITE"
SIMPLIFIED WATER TREATMENT
Balances INDUSTRIAL WATERS
THE NATURAL WAY!

"BAERITE" IS . .

. . all pure organic material.

*a simple organic addition to water which duplicates "nature's own" method.

. . *NOT* a chemical dosage.

. . absolutely *harmless* to all equipment.

. . the simplest, error-proof water treatment available.

. . already proved successful in hundreds of varied installations.

. . guaranteed to perform satisfactorily for you.

* Nature creates some waters so balanced that rust, scale, and corrosion do not result. These water supplies are too rare for you to depend on so . . . "Baerite" provides the simplified treatment that *balances* industrial waters the *natural* way . . . *NOT* by chemical dosage. Send the coupon below for a complete explanation of the "Baerite" *natural* method.

WATER TREATMENT COMPANY of America
1161 Hodgkiss Street • Pittsburgh, Pa.

WATER TREATMENT COMPANY of America
1161 HODGKISS ST., PITTSBURGH, PA.
Please tell me how "Baerite" duplicates Nature's method of "balancing" water.
Company .....
Address .....
Name ..... Title .....

publications of various kinds. That, at least part of the technical information on metering and control in these scattered papers and other publications has been made available in this book will be welcomed by many engineers in power and industrial plants. Here is a new text designed to cover in a practical and theoretical way the measurement and control of the four fundamental physical factors encountered in industrial processing and manufacturing; temperature, pressure, fluid flow and liquid level. The work is divided into 11 chapters: Standards; pressure and vacuum gages; indicating and recording thermometers; high-temperature pyrometry; theory of differential-pressure flowmeter primary measuring instruments; differential flowmeter secondary measuring, recording and integrating elements and volumetric flowmeters; liquid-level measurments; telemetering, automatic control theory; and automatic control mechanisms. There is also an abundance of easily read information for those interested in the more practical side of metering and control.

NEMA Turbine-Generator Recommended Practice. *Published by National Electrical Manufacturers Association, 155 E 44th St, New York, N. Y. 16 pages, 8x10½ in.; stiff paper binding. Price 50 cents.*

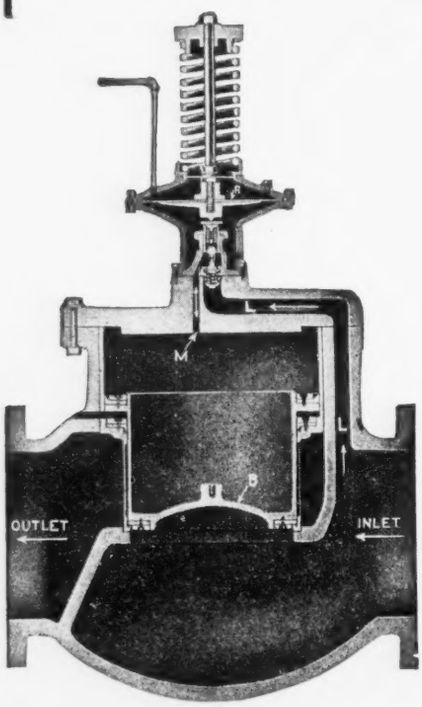
Practices contained in this standard covers direct-connected sets for 60-, 50- and 25-cycle operation and direct-current geared sets. It is divided into three sections: turbine units; synchronous generators for steam-turbine drive; and direct-current generators for steam-turbine drive. Anyone interested in the design and application of these units will find this standard a useful and practical publication.

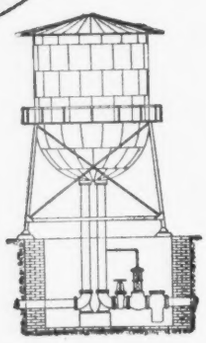
Brief Reviews

Automatic Valves. *Catalog No. 70 Published by Foster Engineering Co, 109–117 Monroe St, Newark, N. J. Limited distribution (see below).* Substantial spiral-bound book gives detailed information on reducing valves, temperature regulators, pump governors, relief and back-pressure valves, and presents a variety of data relating to regulator capacities, steam flow, etc. A copy of this catalog will be sent to executives and engineers engaged in those industries serving national defense if request is written on company letterhead.

LAWRENCE, KANS.
HOLLAND, MICH.
MUNICIPAL
LIGHTING PLANTS
Profit with
HAYS
automatic-centralized
COMBUSTION CONTROL
The aim of municipal lighting plants and public utility companies is to manufacture electricity at the lowest possible cost. They have found that one of the greatest cost savers is automatic combustion control. Many have found also that HAYS centralized control is simple to install, understand and maintain. A few of these are illustrated. What is good for the utilities is good for your power plant: cost saving is a necessity with any steam generating plant. Write for further data.
THE MODERN SYSTEM
it's Electrical!
HANNIBAL, MO.
FULTON, MO.
The HAYS CORPORATION
SINCE 1901
COMBUSTION INSTRUMENTS AND CONTROL
MICHIGAN CITY, INDIANA, U.S.A.
FREMONT, NEB.
WINNETKA ILL.

Golden Anderson SPECIALTY VALVES





ALTITUDE CONTROL

• Hold efficiency at an even level by equipping your tank or standpipe with G-A Altitude control valves. You'll get a constant, automatic water level at all times, with no overflow. This valve is positive in action, with no water or hammer shock. Comes in sizes of 2" to 36", in either globe or angle pattern. Air and water cushioned, it also includes full bronze trim with no metal contacts. Write for your free copy of the G-A catalog . . . it completely describes the entire line.

also

Altitude Control . . .
Pressure Reducing . . .
Throttle and Emergency Stop . . .
Check Valves, etc.

GOLDEN-ANDERSON VALVE SPECIALTY CO.

FULTON BLDG. PITTSBURGH, PA.

NEW POWER CONSTRUCTION

Construction to Come

Arizona-California-Nevada — Bids Dec 18, by Bureau of Reclamation, Customhouse, Denver, Colo., furnishing, del bus structures, oil circuit breakers, also generator neutral reactor for Unit N-7 or Units N-7 and N-8, in Boulder power plant, Boulder Canyon Project.

Ariz., Florence—War Dpt 20 St and Constitution Ave, N. W., Wash., D. C., plans by Headman-Ferguson & Carollo, archts and engrs, Home Builders Bldg, Phoenix, constructing camp, 300 miscellaneous bldgs, utilities. Approx. $4,507,407.

Ariz., Miami—Castle Dome Copper Co, subsidiary Miami Copper Co, 61 Bway, New York, N. Y., plans constructing copper plant, $9,000,000. Defense Plant Corp will finance.

Ark., Malvern—Aluminum Co of America, Gulf Bldg, Pittsburgh, Pa., plans constructing aluminum plant, 128,000,000 lb annual capacity, at Lake Catherine, near here, for War Dpt $33,000,000. Defense Plant Corp will finance.

Ark., Stamps—McKamie Gas Cleaning Co, plans constructing sour gas desulphurization plant, near here, $500,000.

Calif., Fairfield — Bids Dec 12, by Superva Solano Co, constructing sewage pump plant and odor control plant, ¼ mi north of Vallejo.

Calif., Inglewood—Los Angeles Bd P Wks, City Hall, Los Angeles, plans by J Austin and S Spaulding, Chamber of Commerce Bldg, Los Angeles, and takes bids after Jan 1, constructing 2-story bsmnt, structural steel, rein-con administration and passenger bldg, air mail and express and appurtenant imprvs, landing field, Los Angeles Municipal Airport, Mines Field, $1,500,000. L Aldrich, City Hall, Los Angeles, city engr.

Calif., Los Angeles—Bohn Aluminum & Brass Corp, 1400 Lafayette Bldg, Detroit, Mich., plans constructing aluminum extrusion plant, $1,753,000 for land and buildings, $3,785,000 for machinery and equip. Defense Plant Corp will finance.

Calif., Oakland—Bids Nov 19, by Directors East Bay Municipal Utility Dist, 512 16 St, Piedmont, pump, plant.

Calif., Pittsburg—Columbia Steel Co, Russ Bldg., San Francisco, plans imprv steel and pig iron plant, $50,000,000. Defense Plant Corp will finance.

Calif., Salinas—Alisal Sanitary Dist, Salinas, plans constructing saitary sewerage sys, incl collection, trunk and outfall sewer lines, pump, stations, treatment plant, $356,134.

Colorado—Bureau Reclamation, Customhouse, Denver, rejected bids Oct 20, constructing Granby Dam and dikes, Colorado-Big Thompson. Will readvertise.

Colo., Denver—Bids about Jan 1, U. S. Eng, Denver, constructing sewage treatment plant, trickling filter type. Fitzsimmons Hospital, $70,000. R J Tipton Eng Co, 1st Natl Bank Bldg, engrs.

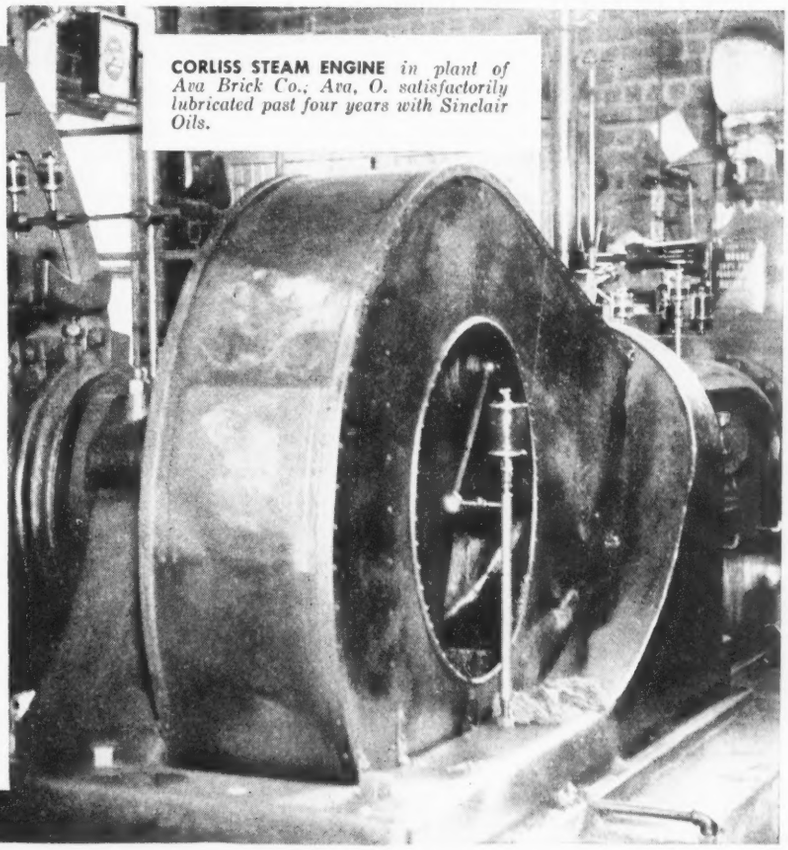
Conn., Hamden—Acme Wine Co., 1255 Dixwell Ave, receiving bids from (invited list of bidders) constructing 1-story, brick, steel, concrete power house, $60,000. Westcott & Mapes Inc, 139 Orange St, New Haven, engr.

Conn., Mystic—U. S. Maritime Comm, 14 St between E St and Constitution Ave

DEFENSE DRIVE bans unnecessary lay-offs. Proper lubrication prevents forced shut-downs. For *STEAM ENGINES* there are . . .

. . . SINCLAIR STEAM CYLINDER OILS suited to any combination of operating conditions. You'll find a Sinclair oil that *correctly* meets your engine's speed, pressure, temperature, moisture condition, and steam recovery requirements. Write for details, or lubrication counsel, to nearest Sinclair office or to Sinclair Refining Company, 630 Fifth Ave., New York, N. Y.

Write for "The Service Factor"—a free publication devoted to the solution of lubricating problems.



CORLISS STEAM ENGINE *in plant of Ava Brick Co., Ava, O. satisfactorily lubricated past four years with Sinclair Oils.*

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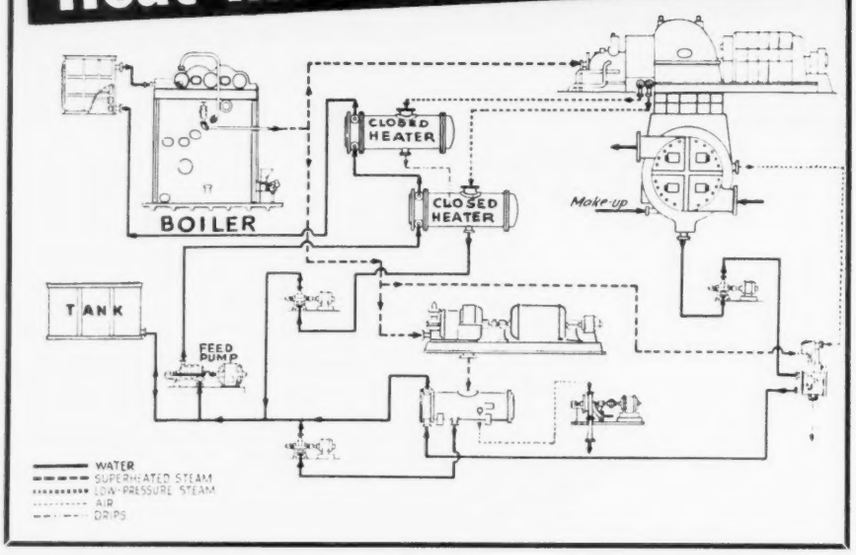
Heat Insulation Products



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Baldwin-Hill Insulation, of the correct type and thickness, properly applied is a primary factor in stepping up production of present power facilities by eliminating lag. It reduces, to the minimum, heat losses through the outside surfaces of the equipment and facilitates a constant control of operating temperatures. Put your heat loss problems up to a Baldwin-Hill insulation engineer.

BALDWIN-HILL CO.

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The hook-up diagrammed above shows a moderately high pressure steam generating station. The chart below shows the application of B-H insulations for highest efficiency.

Boiler	B-H Mono-Block B-H Rockwool Blanket
Closed Heaters	B-H No. 1 Insulating Cement
Tank	B-H Rockwool Blanket
Feed Pump	B-H No. 1 Insulating Cement
All Pipe Lines	B-H No. 100 Pipe Covering

A Complete Line of Heat Insulation Products

B-H

B-H Black Rockwool BLANKET . . . B-H MONO-BLOCK
B-H No. 100 PIPE COVERING . . . B-H MINERAL FELT
B-H No. 1 INSULATING CEMENT . . B-H WEATHERSEAL
and other heat insulations effective up to 2000° F.

N. W., Wash., D. C., plans constructing brick, steel maritime school, $890,000.

Conn., Waterbury—City, Street, Sewer & Water Dpt, 114 Benedict St, plans constructing reservoir and earth dam, 1,000 ft long, 100 ft high. $1,000,000. C A Root, city engr.

Ga., Savannah—Bids Dec. 16, by Pub Wks Officer, Navy Yard, Charleston, S. C., constructing barracks, sick bay, mess hall, galley, heating plant and brig, pier exten, signal tower, radio masts, gas and oil storage, renovating oil bldgs, roads, services to bldg, Sect. Base 4, Cockspur Island, Spec 10595. Extended date.

Ill., Dixon—Illinois Northern Utilities Co, Dixon, plans constructing power plant $6,000,000. Sargent & Lundy, 140 S Dearborn St, Chicago, engrs.

Ill., Scott Field—Bids Dec 5, by U. S. Eng, 816 U. S. Court House and Custom House, St. Louis, Mo., constructing ice storage bldg, motor repair shop, officers' mess and oil house.

Ill., Monsanto (Br East St. Louis)—American Zinc Co of Illinois Cookson Rd, East St. Louis, plans constructing addns, expanding facilities 17,000 tons electrolytic slab zinc and 7,200 tons retort slab zinc annually at plants in Monsanto and Fairmont City for War Dept $4,000,000. Defense Plant Corp will finance.

Ill., Granite City—Granite City Steel Co, plans constructing, equipping plant. $6,300,000. Defense Plant Corp will finance.

Ill., South Chicago (Sta Chicago)—Republic Steel Corp, C A Thayer, engr, Republic Bldg, plans constructing steel plant, 504,000 tons alloy steel ingots yearly. $10,000,000. Defense Plant Corp will finance.

Ill., Winchester—Bids Dec 2, by Hillview Drainage & Lever Dist, C Adams, chn, imprv pump plant. Over $15,000. Stanley Eng Co, Muscatine, engrs.

Indiana—Pub Serv Co of Indiana, Ind, 725 Wabash Ave, Terre Haute, plans constructing 50,000-watt electric generating unit, Dresser Plant, near Terre Haute, Vigo Co, approx. $50,000,000; 35,000 watt electric generating unit, Edwardsport plant, Knox Co, approx $3,500,000; 450 mi high-voltage electric transmission lines from Edwardsport to Louisville, Ky, and from Lafayette to Kokomo, approx $3,500,000; various electric substation facilities, imprvs, approx. $2,500,000.

Ind., East Chicago—American Steel Foundries Co, 410 S Michigan Ave, Chicago, Ill., plans by Albert Kahn & Associates, 345 New Center Bldg, Detroit, Mich., constructing plant for manufacture tank equip, for War Dept, $9,000,000. R D Brizzolars, c/o lessee, engr. Defense Plant Corp will finance.

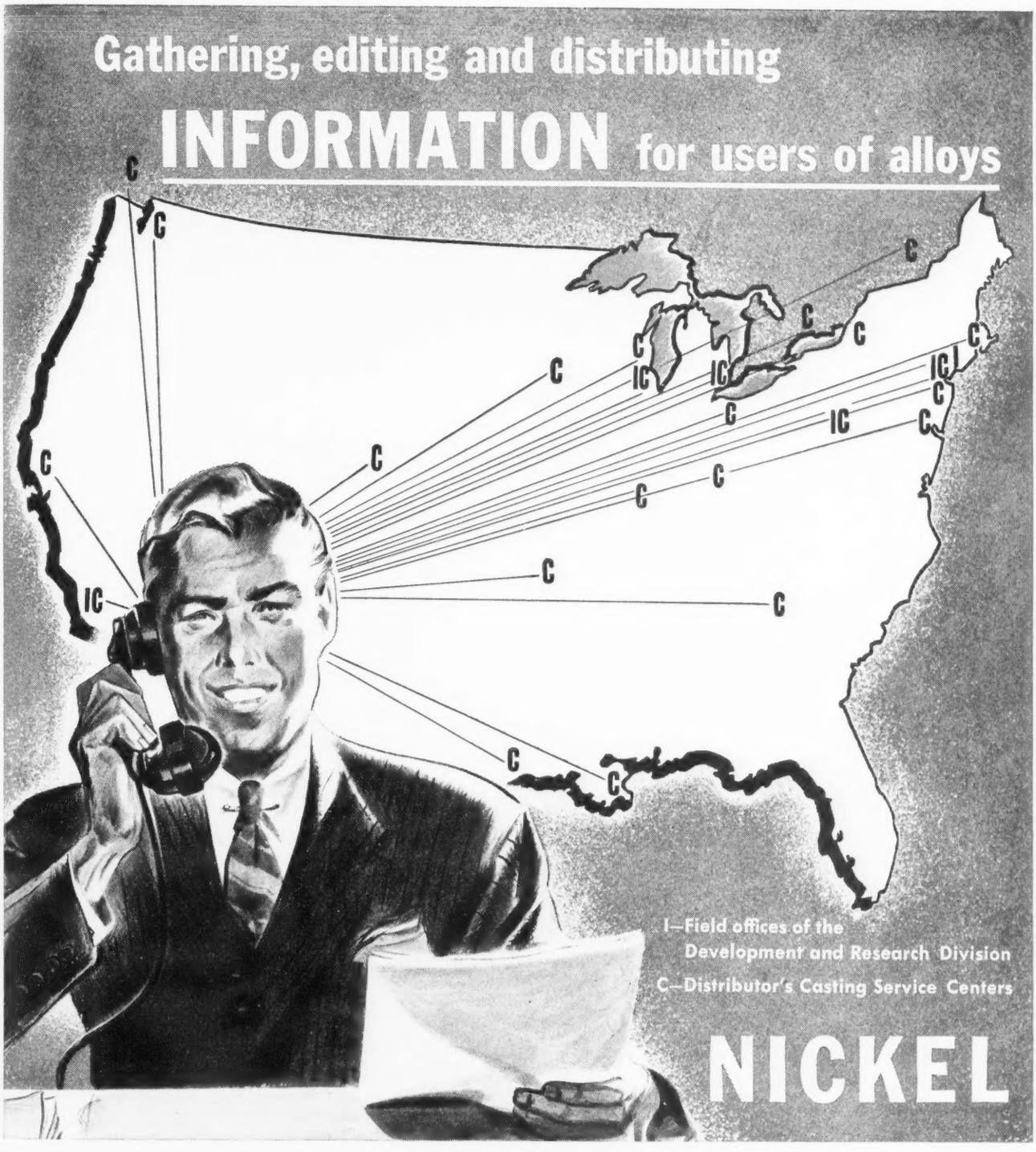
Ind., Newport—War Dept, 20 St and Constitution Ave, N. W., Wash., D. C., plans constructing Wabash River Ordnance Works, $53,500,000 incl equip E I du Pont de Nemours, du Pont Bldg, Wilmington, Del., will operate.

Kan., Kansas City—City plans installing power piping in connection with power plant addn. Over $25,000. Burns & McDonnell, 107 W Linwood Blvd, engrs.

Kan., Winfield—City, F E Jarvis, mayor, plans installing power piping, power plant, $25,000. Extended date. Black & Veatch, 4706 Bway, Kansas City, Mo., engr.

La., Lake Charles—Mathieson Alkali Wks, Lake Charles, plans constructing chlorine and sodium nitrate plant, $6,000,000, dry ice plant $250,000, ammonia and chlorine plant, $1,000,000.

La., Monroe—City, H H Benoit, mayor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INFORMATION for users of alloys
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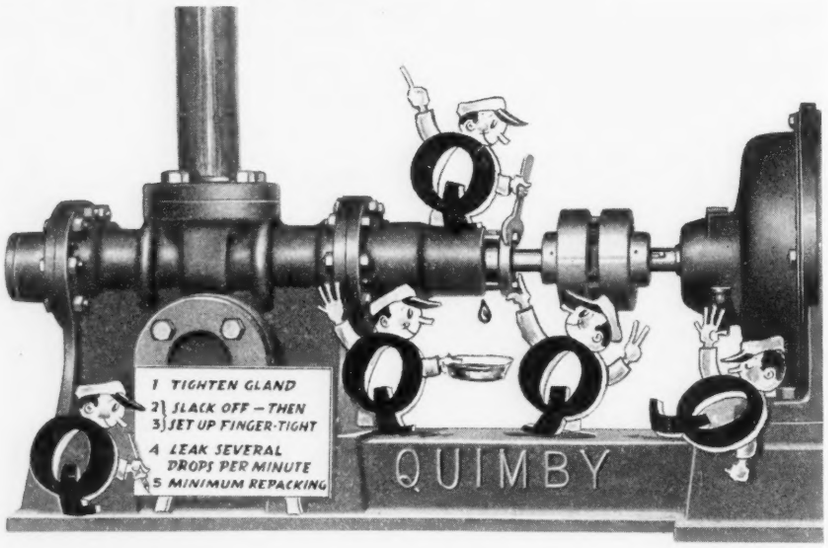
★ PACKING ★



Should the packing glands leak excessively after running the pump a short time, proceed as follows:

1. Tighten glands enough to make sure all rings of packing are close together.
2. Then, slack off nuts on the glands so that no excessive strain is on the packing.
3. After the packing has pushed the gland to its normal position, set up nuts finger-tight on glands.

For proper operation, the glands should be allowed to leak several drops a minute—a slight leakage will keep the packing moist and prolong its life. Due to the design of Quimby screw pumps, a minimum of repacking is required. The action of the screws continually forces the oil toward the center of the casing and away from the gland, so that the packing carries only suction pressure. Thus, with proper operation Quimby pumps require a minimum of attention and maintenance.

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QUIMBY SCREW PUMPS

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and W D H Rodriqueg, comm Finance & Utilities, plans constructing power plant addn. $40,000. Burns & McDonnell, 107 W Linwood Blvd, Kansas City, Mo., engrs.

Md., Baltimore—City plans constructing 1-story, 60x90 ft, brick, terra cotta sewage pump sta, concrete fdn, Broaning Hy.

Md., Sparrows Point—Bids about Nov. 17, by Bethlehem Steel Co, Sparrows Point. City plans constructing pump sta, installing ½ mi 48 in. steel welded pipe, incl coagulators, clarifiers, settling basins, $2,000,000. Extended date. Whitman, Requardt & Smith, 1034 St. Paul St, engrs.

Mass., Camp Edwards—Con. QM Camp Edwards, bids early in January, constructing barracks, warehouses, mass bldgs, hospital facilities, chapels, pump station, roads, sewers, mains for increased capacity Army Cantonment, $3,200,000. Whitman & Howard Inc, 89 Broad St, Boston, engrs.

Mass., Harvard—Water Dpt, Town Hall, plans constructing water supply sta, approx 10,000 ft 6- to 12-in. ci water pipe, 250,000 gal steel standpipe, wells, 14x20 ft, brick pump sta, appurtenances, $480,000. PWA. H E Bailey, 177 State St, Boston, engr.

Mass., Shirley—Water Dept, Town Hall, plans constructing 2,500 ft 6 in. pipeline, gravel-packed well, 12x15 ft pump station, $20,000. DPW. Awaiting federal approval. H E Bailey, 177 State St, Boston, engr.

Michigan—Southeastern Michigan Rural Electric Cooperative Inc, Adrian, plans constructing additional generating facilities. $25,000 REA allot.

Mich., Adrian—Bohn Aluminum & Brass Corp, 1400 Lafayette Bldg, Detroit, plans constructing aluminum extrusion plant. $1,415,000 for land and buildings, $2,520,000 for machinery and equip. Defense Plant Corp will finance.

Mich., Detroit—Vickers, Ind, 1400 Oakman Bldg, plans constructing plant for manufacture aircraft equip for War Dept. $3,656,503 for land and buildings, $4,934,454 for machinery and equip. Defense Plant Corp will finance.

Mich., Flint—Fisher Body Div, General Motors Corp, General Motors Bldg, Detroit, plans constructing 1-story brick, steel, rein-con plant for manufacture of tanks, $4,800,000. Defense Plant Corp will finance.

Mich., Highland Park (Br Detroit)—Ex-Cell-O Corp, 1200 Oakman Bl, plans constructing plant for manufacture aircraft engine parts, for Navy Dept $498,000 for land and buildings, $1,892,000 for machinery and equip. Defense Plant Corp will finance.

Miss., Columbus—Bids Dec. 10, by U S Eng, Federal Bldg, Mobile, Ala., constructing 120 ft temporary hangar, boiler house, Advanced Twin Engine Flying School.

Mo., Clayton (St. Louis P O)—Bids Mar 4, by St. Louis Co, c/o W E Miller, clk, Court House, constructing 4- and 5-story, bsmnt, 42x196 ft and 56x66 ft brick, rein-con health center, boiler house addn, and tunnel, County Hospital, North and South Rd, $522,500. Wm B Ittner, Inc, 408 Bd Educ Bldg, 911 Locust St, St. Louis, archts and engrs.

Mont., Fort Peck—Bids Dec. 12, by U. S. Eng, 1201 Davidson Bldg, Kansas City, Mo., constructing power house superstructure and surge tank bldg, installing penstocks and butterfly valves for Fort Peck project. $2,000,000. Extended date.

Neb., North Platte—Bids Dec 16, by S W Throckmorton, city clk, constructing municipal light and water department bldg. $40,000. C C Coursey, city archt.

Sign of the Times

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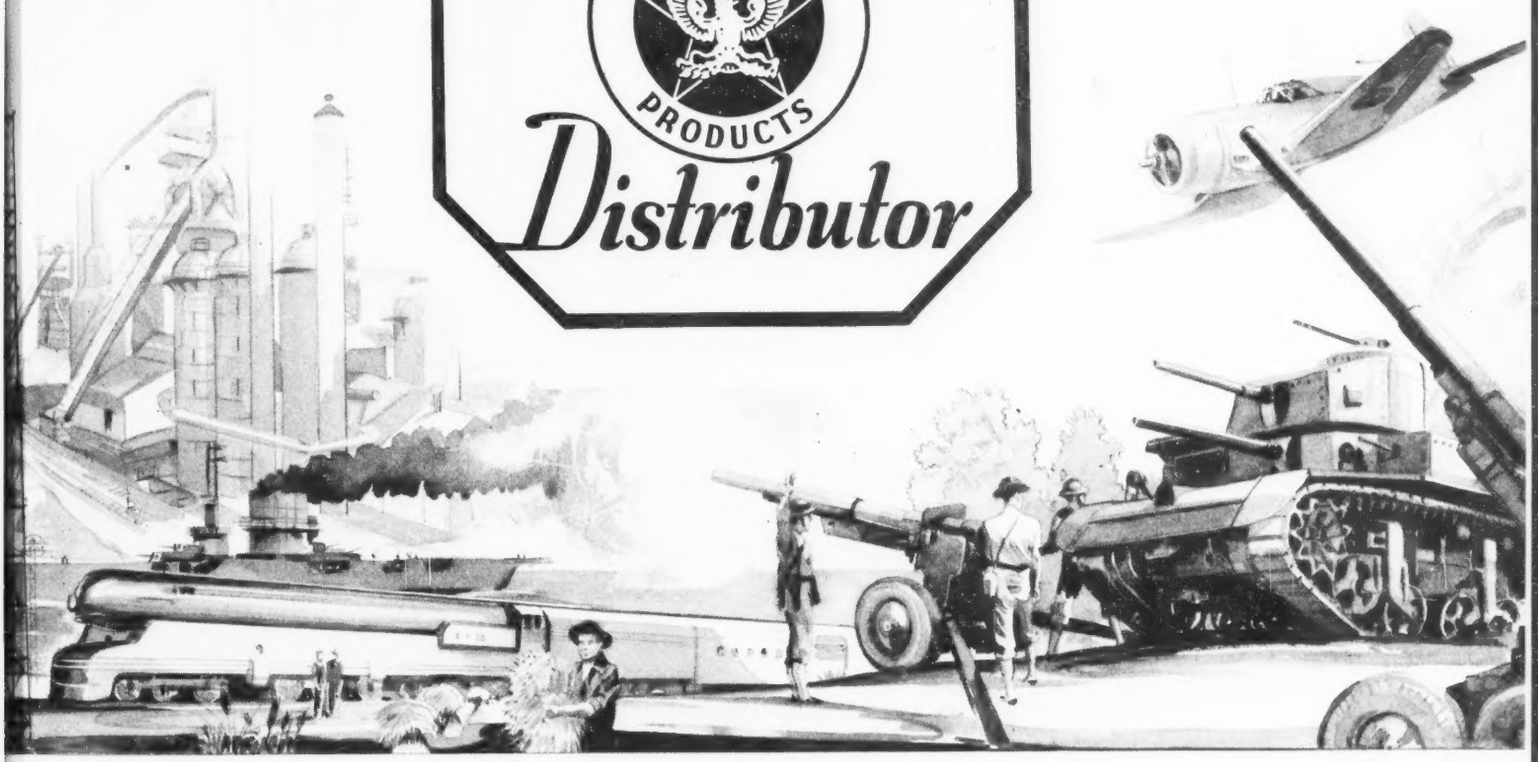
REPUBLIC RUBBER PRODUCTS



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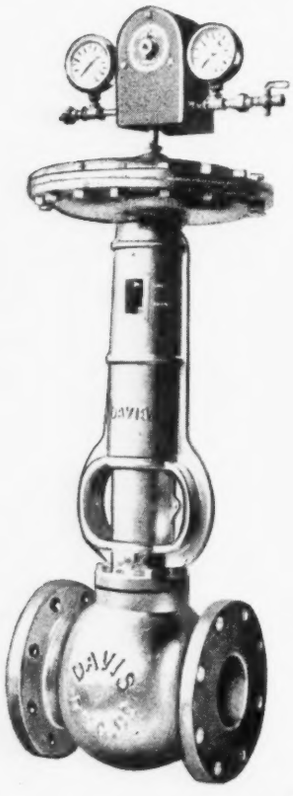


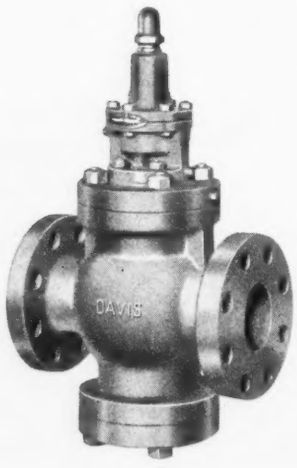
No. 401 for Pressure Reducing . . . Relief . . . Back Pressure Service

LEFT: The Davis No. 401 is a rugged, compact regulator for use indoors or outside where conditions demand accurate, sensitive pressure control. Adjustment can be quickly made to change the No. 401 from direct to reverse-acting without dismounting or changing valve action. Pilot-operated pressure controller insures positive pressure control at all times, and a simple setting on the face of the controller changes the pressure reduction or relief pressure as desired. Operation is simple, insuring long, trouble-free life and low maintenance.

Davis No. 401 is available in sizes from ½ in. to 10 inches in steel, semi-steel or bronze body, with bronze, monel or KA2 trim. For initial pressures up to 600 lbs. and reduced pressures from 1 to 500 lbs.

No. 40 for Heavy Duty Variable Load Conditions

RIGHT: No. 40 is a self-contained, pilot operated type reducing valve for handling heavy duty, variable load conditions. Unaffected by high pressure fluctuations, pressure reduction is maintained regardless of flow conditions. Full pipe size port area gives large capacity, single seat insures tight closing. Sizes from ½" to 10". Available in materials suitable for any pressure up to 400 lbs.



GETTING the right regulator for the job is easy when you make selections from the Davis line: eighteen different types to choose from . . . Sizes up to 24" . . . for pressure up to 1,500 lbs. . . . for steam, gas, air, water, or oil. Ask for handy "Service Selector Chart" and complete information. DAVIS REGULATOR CO., 2540 S. Washtenaw Ave., Chicago, Illinois.

DAVIS REGULATOR COMPANY

Neb., Wahoo—War Dept, 20 St and Constitution Ave, N. W., Wash., D. C., plans constructing Nebraska Ordnance Plant for bomb loading. $25,000,000. Giffels & Vallet, Inc, 1000 Marquette Bldg, Detroit, Mich. engrs. Firestone Tire & Rubber Co, 1278 S Main St, Akron, O. will operate.

N. J., East Paterson—City plans constructing pump station, sewage-disposal plant alterations, addns $38,645. Applied for DPW funds. McClave & McClave, 600 George Rd, Cliffside Park, engrs.

N. J., Hoboken—Tietjen & Lang Dry Dock Co, 1 B'way, New York, N. Y., bids soon, constructing ship-repair plant, facilities, incl. shipways, piers, repair shops, office bldg, warehouse, utilities for Navy Dept. $2,000,000. Defense Plant Corp will finance.

N. J., Jersey City—City plans constructing building addns, alterations, imprv existing bldgs, Medical Center. $5,078,000. DPW funds sought. J T Rowland, 30 Journal Square, archt.

N. J., Newark—Port Newark Shipbuilding Co, 17 Battery Pl, New York, N. Y., plans constructing 1-story, 300x350 ft frame mould loft bldg, 2-story, 100x300 ft frame office bldg, 2-story, 75x150 ft frame storage bldg, 1-story, 75x75 ft, frame, power plant and gate house. Fort Newark, for U. S. Maritime Comm.

N. Y., Binghamton—Plans constructing pump sta. $30,000. J A Giles, City Hall, engr.

N. Y., Brooklyn—Dept Hospitals, 125 Worth St, New York, plans constructing psychiatric pavilion $2,105,000 and power plant exten. $942,000, both Kings County Hospital.

N. Y., Brooklyn—Bids Nov. 24, by Dept P Wks, Municipal Bldg, New York, constructing steam, brine and water piping and equip for power plant addition work, Greenpoint Hospital.

N. Y., Buffalo—Universal Smelting & Refining Corp, 2548 Elmwood Ave, plans constructing smelting plant. Over $1,000,000. Whiting Corp, Harvey, Ill., engrs.

N. Y., Iona Island—Bids Dec. 23, by Pub Wks Officer, 3rd Naval Dist, 90 Church St, New York, plans constructing service extens to new bldgs, heating, electrical and water distr sys.

N. Y., Massena—City constructing sewage disposal plant, incinerator. Over $25,000. Wm S Lozier, Inc, 10 Gibbs St, Rochester, engrs.

N. Y., Shortsville—Grand Bag & Paper Co, H Arthur Gilman, mgr, plans constructing power plant addn. $40,000.

N. C., Wilmington—City constructing WW sys. addn, imprvs, new pump station, filtration plant, elevated storage tanks, water supply and distr sys addn, $1,226,000, DPW.

Ohio—Bids Dec 18, by U. S. Eng, 925 New Federal Bldg, Pittsburgh, Pa., constructing Berlin Dam, concrete earth, Mahoning River, Mahoning and Portage Counties.

Ohio, Amherst—Bids Nov 19, by W H Barber, village clk, constructing Contrs 2 and 10, electric generating plant, two 625-750 kw turbo-generator units, miscellaneous iron work, etc. F G Browne, Marion Bldg, Marion, engr.

Ohio, Dayton—Chandler-Evans Corp, South Meriden, Conn., and Dayton, Ohio, plans constructing plant for manufacture aircraft equip for War Dept., $303,124 for land and buildings, $842,003 for machinery and equip. Defense Plant Corp will finance.

Ohio, Painesville—Diamond Alkali Co, Fairport Harbor, plans constructing plant

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GARLOCK packings and gaskets give long, dependable performance month after month because of our *quality-controlled* method of manufacture.

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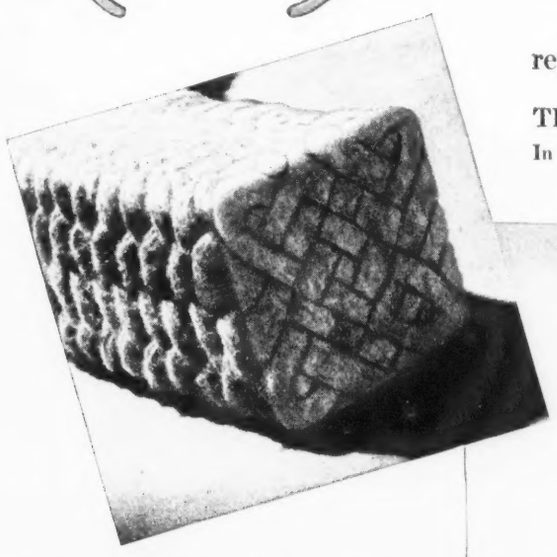

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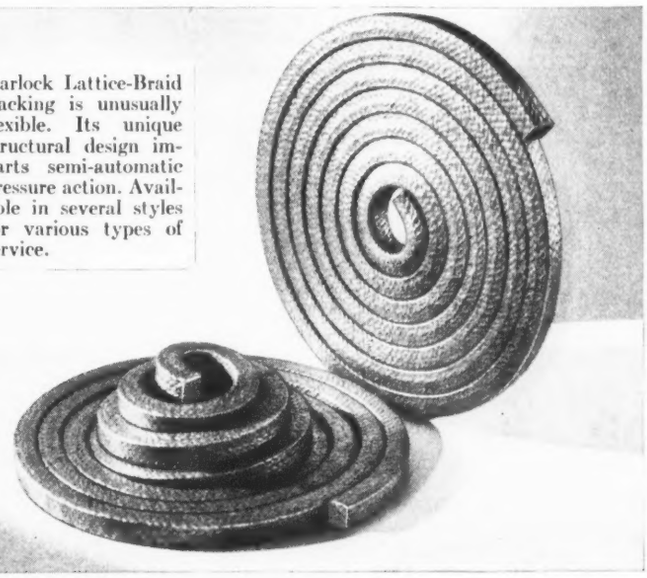

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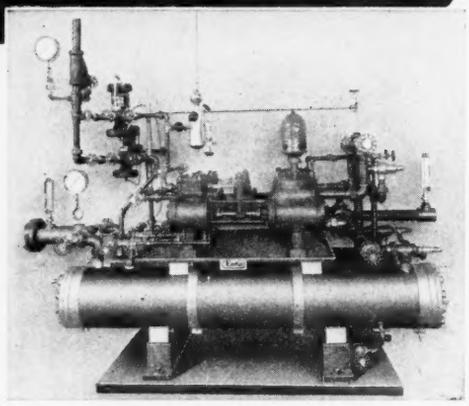
There's no time NOW for POWER PLANT FAILURE



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Duplicate pumps and heaters are used, each of full capacity. These are interconnected so that operation is obtained with any combination of pump and heater. Screw or rotary pumps, with motor or turbine drive may be furnished, whichever are best suited to the installation.

The finished product is a complete unit, ready to place on foundation and to receive pipe connections.

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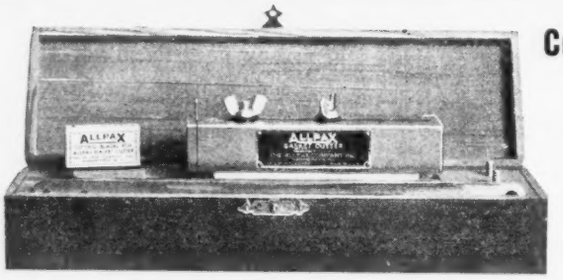

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High Pressure Steam at Low Cost . . . economical to buy and economical to operate. Compact yet easily accessible. Easy payments in accordance with U.S. Government regulations thru our Finance Corporation.

For 6" rule with scale for reading pipe sizes, write Dept. 99K-I.

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KEWANEE, ILLINOIS

for manufacture magnesium, to Austin Co, 16112 Euclid Ave, Cleveland. Est $16,000,000. Defense Plant Corp will finance.

Ohio, Warren—Copperweld Steel Co, S D Williams, vice pres in charge, plans constructing 100,000-ton annual capacity ingot steel plant. $4,000,000. Defense Plant Corp will finance.

Okla., Rush Springs—Rural Electric Cooperatives, Tipton F Higginbotham, secy, Norman, plans constructing power generating plant, southwestern Oklahoma. $2,300,000 REA allot.

Ore., Fairview—Defense Plant Corp, 811 Vermont Ave, N. W., Wash., D. C., plans constructing aluminum fabricating plant. $20,000,000.

Pa., Large—Bd Comrs Jefferson Twp, W W Eggers, secy, Twp Hall, Large, plans constructing water sys, pump sta, filtration facilities, Jefferson Twp, Chester Engineers, 210 E Parkway, NE Pittsburgh, engrs.

Pa., Latrobe—Bids Dec. 3, by Prack & Prack, archts, 517 Martin Bldg, NS, Pittsburgh, constructing general contract, electrical and structural-steel fabrication for structural-steel frame Forge Shop 2, covered wharf and craneway, and open craneway, for American Locomotive Co. C Davies, Latrobe, in charge.

Pa., Plymouth—Bids Dec 29, by U. S. Eng, 332 Post Office Bldg, Baltimore, Md., constructing 2 pump stations, 3 rein-con relief culverts.

R. I., Newport—Bids Dec 5, by Pub Wks Officer, Naval Training Station, Newport, constructing incinerator, Naval War College.

R. I., Quonset Point—Bids Dec 9, by Construction Officer, Naval Air Base, Quonset Point, constructing incinerator.

S. C., Charleston—City plans constructing enlarging, imprv garbage and rubbish incinerator facilities. $148,000. DPW.

S. C., Charleston—Bids Dec 17, by Pub Wks Officer, Charleston Navy Yard, constructing electric shop exten.

Tenn., Nashville—State, P Cooper, gov. plans constructing power generating plant, penitentiary, convict labor. $280,000.

Texas—Brazos River Transmission Electric Cooperative, Inc, 4613 Camp Bowie Blvd, Fort Worth, plans constructing generating and transmission facilities. $1,000,000 REA allot.

Texas—Monsanto Chemical Co, 1700 S 2 St, St. Louis, Mo., plans constructing plant and equip for manufacture chemical products for synthetic rubber, in or near Galveston Co, for Rubber Reserve Co, $2,200,000. Defense Plant Corp will finance.

Tex., Beaumont—City constructing 100-ton garbage incinerator, $102,262. DPW.

Tex., Camp Barkeley—War Dept, 20 St and Constitution Ave, N. W., Wash., D. C., plans constructing replacement center, 2-story barracks, etc, $7,220,000.

Tex., Corpus Christi—City voted $100,000 bonds, constructing incinerator. Will apply for federal funds. G Blackburn, city engr.

Tex., Daingerfield—W O Irving & Associates, Daingerfield, surveys constructing iron ore smelting plant.

Tex., Daingerfield—Texas Iron, Steel & Coke Co, c/o W O Irving, pres, Natl Bank of Daingerfield, plans constructing iron-ore smelting reduction plant between here and Hughes Springs. $28,000,000.

Tex., Denison—Bids Dec 12, by U. S. Eng, Citizens Bank Bldg, for two 36,842

Opened and Closed 500,000 Times

Fig. 0828

Illustration shows an old Fairbanks Sphero Valve, Fig. 0828, in plant of Stokes Bros. Mfg. Co., Freehold, N. J., that was in service for over ten years. This valve was opened and closed every two minutes for an average of five or more hours a day.

This old valve was recently replaced by a new type Fairbanks Sphero Ball Valve, Fig. 0851.

Fairbanks Sphero gives unusual service for blow-off purposes or wherever a full flow, quick-acting valve is desired.

Instead of the usual wedge or disc, Fairbanks Sphero has a revolving ball plug which wipes the seating surface clean. Its shearing action cuts through heavy solids and liquids. There is nothing on which foreign matter can accumulate.

The opening in the ball plug is the same size as that in the pipe, consequently there are no obstructions, no frictional resistance.

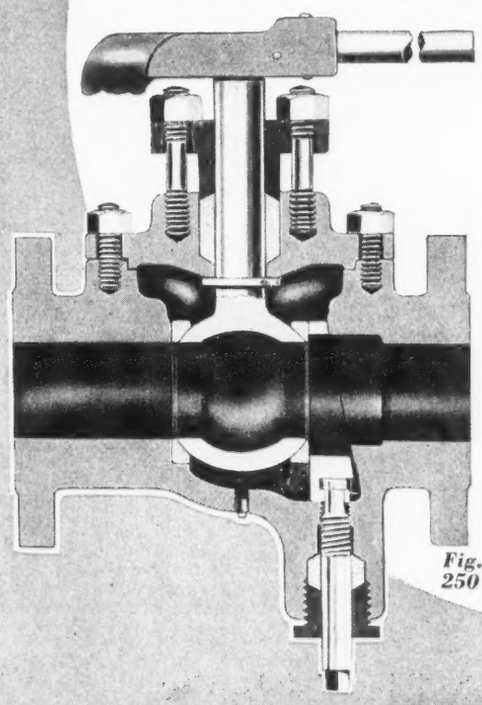

Fig. 0851
250 lbs. steam pressure

Wear on seat rings is reduced to a minimum by the rotary motion of the ball. Seat rings can be kept permanently tight by adjusting the wedge at bottom.

It can be opened or closed with a quarter turn of the handle. A positive stop tells when fully open or closed.

Seat rings or other parts which may become worn, can be replaced without removing valve from the line.

For Catalog No. 21 and name of our nearest distributor write The Fairbanks Company, 397 Lafayette St., New York, N. Y.

F

Fairbanks Company
397 Lafayette St., New York, N. Y.
Please send your catalog No. 21 and name of nearest distributor.

Name .....

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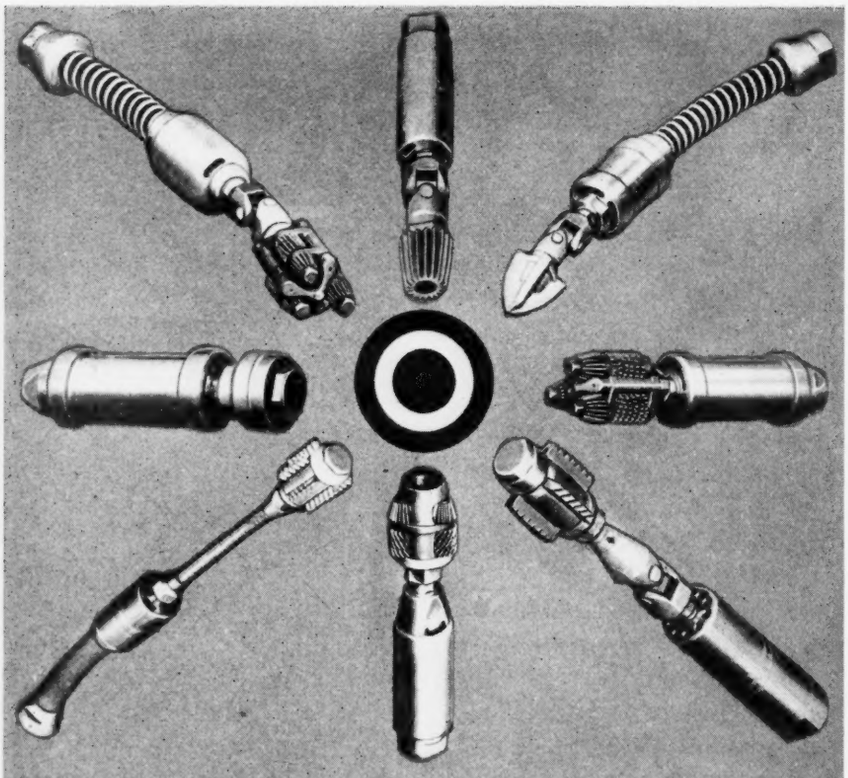
City ..... *State* .....

Fairbanks Sphero Valves



"TIME IS SHORT"

Now that we are in the war, the real significance of the warning conveyed by the thousands of posters placed in thousands of plants throughout the country by the Federal Government is brought home to us. Delays in production will surely mean tremendous loss of life and may well mean national disaster.

Wilson Tube Cleaners have *extra power, extra strength,* and *extra efficiency.* This enables them to clean tubes in *less time* and at *lower cost* and thus *reduce* boiler cleaning time and *increase* production.

There is a Wilson Tube Cleaner, cutter head, brush, or other accessory to overcome *quickly* and *thoroughly* any scale or sludge deposit accumulating in any tube or pipe.

Write for the name of our representative nearest to you or for a copy of our thirty-six page catalog fully describing and illustrating the complete line of Wilson tube cleaning equipment.

THOMAS C. WILSON, Inc.
PIPE AND TUBE CLEANERS EXCLUSIVELY
47-28 37th Street Long Island City, N. Y.

"AMBEST" *good to the last stroke on ANY good rod . . .*

The tougher the job—the more convinced you'll be that "AMBEST" is the economical, long-lived packing to use. "AMBEST" is *universal* in application because it is equally suitable for reciprocating or centrifugal rods—for engines, compressors, pumps, valve stems—for all pressures and temperatures up to 550° F.

Use "AMBEST" on *any good rod.* It's easy to apply, instructions on every can, long-lived—a safe, metallic packing that is lubricated and graphited for smooth, tight, anti-friction service.

PATENTED "EUREKA" TRADE MARK

TRY AMBEST ONCE . . . *and* You'll USE IT ALWAYS . . .

Send for our 36 page catalog covering the "EUREKA" line of Flax, Asbestos, Rubber and Metallic Packings.

EUREKA PACKING CO., 294-296 46th St., BROOKLYN, N. Y.

kva alternating-current generators, auxiliaries, for Denison Dam and reservoir, Red River. Extended date.

Tex., Edinburg—A A Aldrich, mayor, plans purchasing, imprv electric light power plant and distr sys. $300,000.

Tex., Galveston—Monsanto Chemical Co, 1700 S Second St, St. Louis, Mo., plans constructing chemical products factory in connection with synt'hetic rubber production. $2,200,000. Defense Plant Corp will finance.

Tex., Houston—Harris Co Flood Control & Imprvt Dist, Houston, bids soon, constructing Unit 2, earthen and concrete flood control dam. Addicks, near here, $2,000,000, Unit 1, earth and rein-con Barker Dam for flood control. Barker Twp. near here, $3,500,000.

Tex., Houston—Bids Dec 20, by U. S. Eng, Federal Bldg, Galveston, constructing Barker Dam, near Addicks, 14 mi. from here on Buffalo Bayou, for Harris County Flood Control & Imprvt Dist H I Washburn, aud. County Court house. $2,-000,000. Extended date. A C Finn, Bankers Mortgage Bldg, engr.

Tex., Port Arthur—Gulf Co, Port Arthur and Gulf Bldg, Houston, receiving bids constructing 2,500 bbl daily capacity gasoline unit, incl alkylation and Houdry-Catalytic cracking plant. $1,000,000.

Tex., Rusk—Judge R Perkins & Associates, Rusk, plans constructing iron-ore plant, unit for charcoal distilling, acitic acid and wood alcohol byproducts. $2,-500,000. RFC loan being negotiated.

Tex., San Antonio—Bids Nov 27, by Con Q M, San Antonio Arsenal, furnishing items 1 and 2, one each generating units.

Tex., Texarkana—City plans constructing sanitary sewerage sys imprvs $315,-000, and 1-story, 27x41 ft brick, concrete incinerator, $79,000. DPW. J J Rady, Majestic Bldg, Fort Worth, and J Montgomery c/o Littlefield Bldg, Austin, engrs.

Tex., Velasco—Dow Chemical Co, Freeport, plans constructing 30,000,000 lb annual capacity magnesium plant, for War Dept. $15,000,000.

Utah, Mt. Emmons—Moon Lake Electric Assn, Inc, plans constructing addnl generating facilities, power plant, $50,000 REA allot. E D Conklin, supt, Mt. Emmons.

Utah, Ogden—Bids Dec 2, by U. S. Eng, 751 S Figueron St, Los Angeles, Calif., constructing Pump Plant 3, Hill Field.

Va., Norfolk—Yards & Docks, Navy Dept, 18 St and Constitution Ave, N. W., Wash., D. C., plans supplemental agreement, additional facilities Naval Operating Base, Contr NOY 4384, to Byrne Organization, 2701 E Fitzhugh St, Dallas, Tex., Est $1,437,000, incl fee.

Washington—Bids Jan 5, by Bureau Reclamation, Customhouse, Denver, Colo., furnishing, installing 3 alternating-current generators for Grand Coulee power plant, Columbia Basin Project, Spec. 1018.

Washington—Defense Plant Corp, 811 Vermont Ave, N. W., Wash., D. C., plans constructing aluminum-fabricating plant at Longview or Vancouver, $14,000,000.

Wash., Bremerton—City bids soon constructing 2 story part bsmnt, 50x102 ft rein-con incinerator. $92,400. DPW. F A Naramore & Assoc, Dexter Horton Bldg, Seattle, archts.

Wash., Spokane — Bonneville Power Admin, P O Box 3537, Portland, Ore., plans constructing substation. $1,000,000.

Wash., Tacoma—Bids Dec. 15, by city furnishing 3 turbines, 3 generators for power plant expansion. Extended date.

Wash., Wapato—Bids Dec 3, by Office

CAN THE FUTURE BE FORESEEN HERE?

To the ancients the night sky was a perpetual mystery, from which glib opportunists predicted the fortunes of love, war and commerce. Ignorant of the simple key to astronomy, the course of the planets around the sun, men of old named them "the wanderers," believed their movements controlled every activity of mankind.

Today men ignore the flight of a planet through space . . . knowing that "he profits most who serves best" is a far better business guide. It is clear to us at Keasbey & Mattison that most of our orders tomorrow will come from you who are using our materials today, that our future depends on continually improving our products so that they will serve you better.

At present we are willingly complying with National Defense requirements, and we realize that this is causing inconvenience to many of our customers in other industries. But our research laboratories are working on improvements and new materials that will help you in the future. In what way can we benefit you most? Can you tell us of a specific problem of yours which might be solved by a new application of asbestos? Anything you suggest will be carefully studied with the hope it will prove practical for us to manufacture. A letter from you now will help us to serve you better in the days ahead.

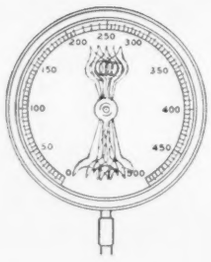
* * *

Nature made asbestos; Keasbey & Mattison has made it serve mankind . . . since 1873.

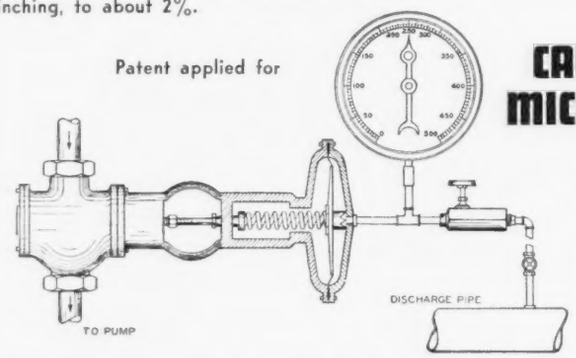
KEASBEY & MATTISON
COMPANY, AMBLER, PENNSYLVANIA

DO YOUR GAUGES HAVE THE JITTERS?

The Campbell Micro-Bean is an all-purpose dampener that operates efficiently with all fluids regardless of viscosity. It will not pinch off with small changes in pressure. The solid brass body minimizes body strain and the 48 to 1 taper of the valve reduces stem and screw compression strain, so far as it affects pinching, to about 2%.



Patent applied for



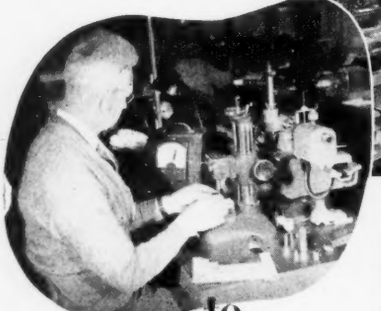
CAMPBELL MICRO-BEAN

For all purposes up to 5000 pounds, the Campbell Micro-Bean will not pinch off and will give any degree of stabilization by merely turning the micro-valve.

An efficient filter section is inserted in the body ahead of the small valve port, affording protection from foreign matter in the fluid. Any scoring that might happen will be microscopic and can be ground out by entirely shutting the valve two or three times. An allowance of 3/16" is left for grinding in the stem, which gives the dampener an almost unlimited life. Send for Catalog. *Some select territories for Distributors are available.*

J. A. CAMPBELL CO.

649 E. Wardlow Road, Long Beach, California



Accuracy to Millionths of an Inch with

The parts for tanks, planes and guns, produced in thousands of separate plants, can only fit together properly if made in standard sizes, to accurate gages. Pratt and Whitney secure accuracy to millionths of an inch by finishing their Hoke precision gage blocks in this air conditioned room at West Hartford, Connecticut.

Standard conditions of 68° F. and 50% relative humidity are maintained, 24 hours a day the year 'round, with Frick Equipment. This working space, covering 16,800 sq. ft., is believed to be more accurately controlled than any other of like size in existence. Full credit is due the Automatic Refrigerating Co., Frick Distributors at Hartford.

Put your air conditioning problem up to the experts who have nearly 60 years' experience back of their recommendations. Write **Frick Co., Waynesboro, Pa.**

TRADE FRICK MARK

Refrigeration

Indian Affairs, 751 S Figueroa St, Los Angeles, Calif., for sychronous motor driven centrifugal-pump unit, accessories for Toppenish Creek Pump, Plant of Wapato Irrigation Project, Contr W41-[illegible]

W. Va., Charleston—Carbide & Carbon Chemicals Corp, 437 East Ave, South Charleston, plans constructing plant for manufacture butadiene for synthetic rubber, for Rubber Reserve Co. Approx $3,500,000. Defense Plant Corp will finance.

W. Va., Charles Town—War Dept, 20 St and Constitution Ave, N. W., Wash., D. C., plans constructing ordnance ammunition storage depot, on 14,000 acre site.

W. Va., Huntington—Bids Dec 2, by U. S. Eng, Huntington, constructing 3 Richmond and Oak Sts pump stations for Local Protection Project for Sect 3, (Guyandot).

Wis., Knowlton—Consolidated Water Power Co, plans constructing dam, power plant. Knowlton Portage Co, transmission lines from dam to village of Brion, Wood Co. $2,122,761.

Wis., Milwaukee—A C Smith Corp, 3533 N 27 St, plans constructing 281x561 ft, 223x601 ft and 176x300 ft plant addns, $877,000. Total including equip $2,760,132. Defense Plant Corp will finance.

Wis., Stiles—Oconto Electric Coop, E G Redman, mgr, Oconto Falls, constructing hydro-electric power plant, Oconto River, $200,000. REA allot.

Wis., Spooner—G B Sage, city clk, preparing plans constructing hydro-electric plant. L A DeGuere, Wisconsin Rapids, engr.

Wis., Waterloo—Bids after Nov 18, by city rebuilding municipal light and power plant. $104,000. Commercial Testing & Eng Co, 307 N Michigan Ave, Chicago, Ill., engr.

Power Lines

POWER's History

POWER was founded in 1884 by E P Harris and H M Swetland. With it was incorporated *Steam*, which had been started by N Hawkins in Chicago two years earlier.

In 1903 POWER purchased and absorbed *Science and Industry*, which was a consolidation of a number of periodicals, namely, *Home Study Magazine, Home Study for Machinists, Mechanic's Magazine, Home Study for Building Trades, Building Trade's Magazine, Home Study for Electrical Workers and Steam Electric Magazine.*

In 1908 POWER absorbed *The Engineer's Review*, of Cleveland, and *The Engineer*, of Chicago. the latter being a consolidation of *The Safety Valve, Lord's Power and Machinery Magazine, The Stationary Engineer, Steam Engineering and The Mechanical Engineer.* When *The Engineer* was purchased, the name of the combined magazine was *Power and the Engineer.* The title was

"A TURBINE SHUTDOWN MEANS A PLANT SHUTDOWN—

SO WE USE

Gulfcrest Oil"

says this Chief Engineer

"We have no operating troubles with this stable turbine oil in service"

Actual photo of a Gulf engineer consulting with chief engineer of manufacturing plant on turbine lubrication.

"THIS turbine is the sole source of power for the 24-hour a day operation of our mill," says this chief engineer. "So we can't take chances with our lubrication. That is why we use Gulfcrest, which we have found to be the highest quality turbine lubricant obtainable. With this Alchlor-Processed oil in service, we get efficient turbine performance and have no operating troubles."

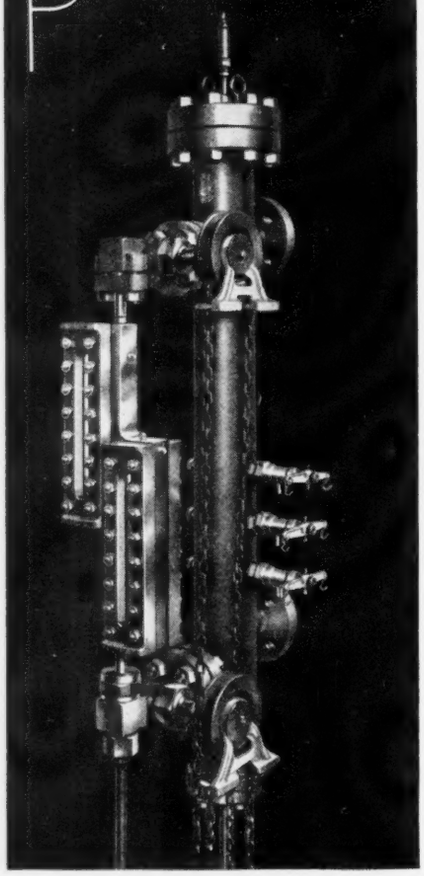
Operating data covering the performance of Gulfcrest Oil in large and small turbine systems throughout the country verify this fact: That Gulfcrest is a turbine oil with unmatched stability. After years of service, this Alchlor-Processed oil shows so little evidence of deterioration that operators find it is in as good condition as when first put into service.

We suggest that you talk with a Gulf engineer about Gulfcrest at your first opportunity. He will be pleased to give you complete details —and you will be under no obligation.

GULF INDUSTRIAL LUBRICATION

GULF OIL CORPORATION · GULF REFINING COMPANY · PITTSBURGH, PA.

POSITIVE
Protection



Yarway's unique Hi-Lo Alarm mechanism utilizes balanced *solid weights* that are as indestructible and unchanging as the metal itself. Operating on the displacement principle, they literally "weigh the water level."

When the high or low water emergency occurs—instant, positive, powerful, hair-trigger *action* results—giving warning of danger by whistle, light, or both.

Yarway Water Columns, eight standard models, iron bodies with screwed connections for pressures up to 250 lbs., forged steel bodies with flanged connections for pressures up to 1500 lbs., are fully described in Catalog WG-1807. Write for a copy and working model.

YARNALL-WARING COMPANY
100 Mermaid Ave. Philadelphia

YARWAY
FLOATLESS HI-LO ALARM
WATER COLUMN

condensed to POWER in 1911. All rights to the preceding titles reserved.

OBITUARIES

GUY F STRAFER, 65, manager of Allis-Chalmers Mfg Co Kansas City district office since 1923, died November 23 after a brief illness. He started with Bullock Electric Mfg Co in 1897 and

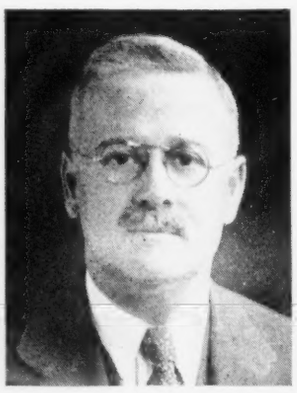
Guy F Strafer

joined the Allis-Chalmers organization when it acquired the Bullock Co in 1904. Mr Strafer went to the Kansas City office in 1907, subsequently becoming its manager.

A H JACKSON, 77, retired vice president and general counsel of the General Electric Co until his retirement in 1929, passed away recently as the result of a heart attack. Mr Jackson was elected to his position in 1922.

GILBERT H TOMPKINS, secretary of Sauerman Bros Co, Chicago, Ill., died suddenly at his home on December 2. He joined the Sauerman organization in 1909 and was with them continuously from that date until the time of his death. He became secretary of the corporation after its incorporation in 1925.

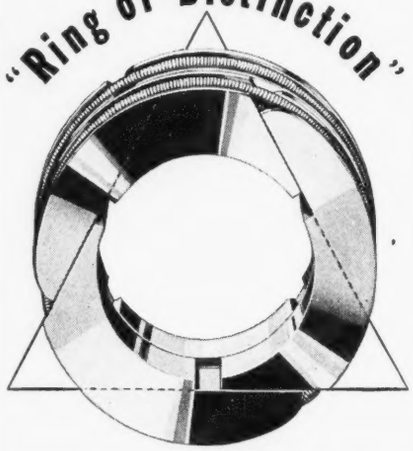
GEORGE S LAWLER, 67, chief electrical engineer of the Associated Factory Mutual Fire Insurance Co's, Boston,



George Lawler

FOR THE DEFENSE OF DEMOCRACY
THE BEST IS NONE TOO GOOD

FRANCE PACKING
has a
"Ring of Distinction"



Imitated but never duplicated, the France ring is manufactured in three sections. The contacting faces form the lines of an equilateral triangle. As the ring is expanded or contracted, the sections must move in or out radially equal distances from the center of the rod to which the ring is fitted.

This fundamental mechanical principle accounts for the efficiency, trouble-free performance and extra-long life of France Metal Packing.

After years of service, when the rings have become worn to such an extent that the sections nearly butt together, further years of additional service can be obtained by cutting off the narrow points of the three sections where they form a part of the inner circumference of the ring. The spring then requires adjustment so that the sections are held to the rod with a slight tension.

For installation in engines, pumps and compressors—under all conditions of service, France Full-floating Metal Packing means true economy in the long run.

Permit France Engineers to analyze your packing requirements. Write for Catalog M-7.

ORIGINAL FRANCE METAL PACKING
Sold on approval
Satisfaction Guaranteed

THE FRANCE PACKING COMPANY
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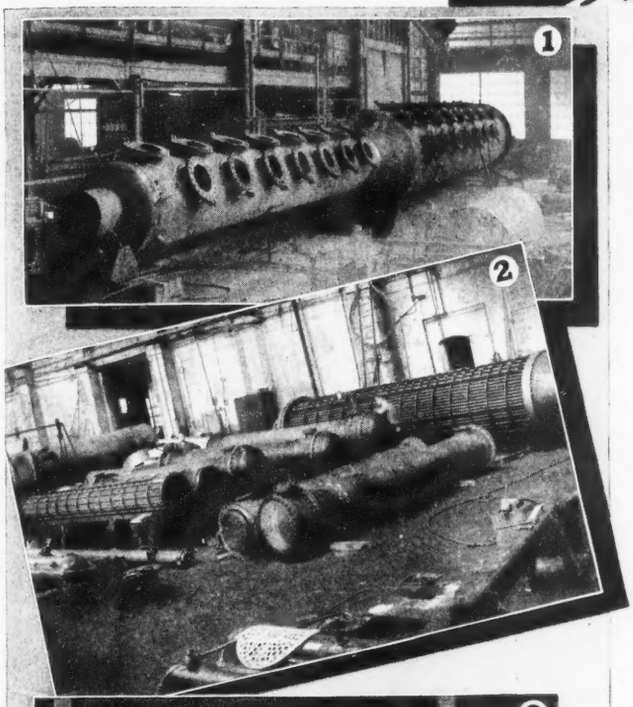
Original
FRANCE
METAL PACKING

A.P.I.—A.S.M.E. and A.S.M.E. CODES • CARBON STEEL AND SPECIAL STEEL

WELDED PRODUCTS by Vogt



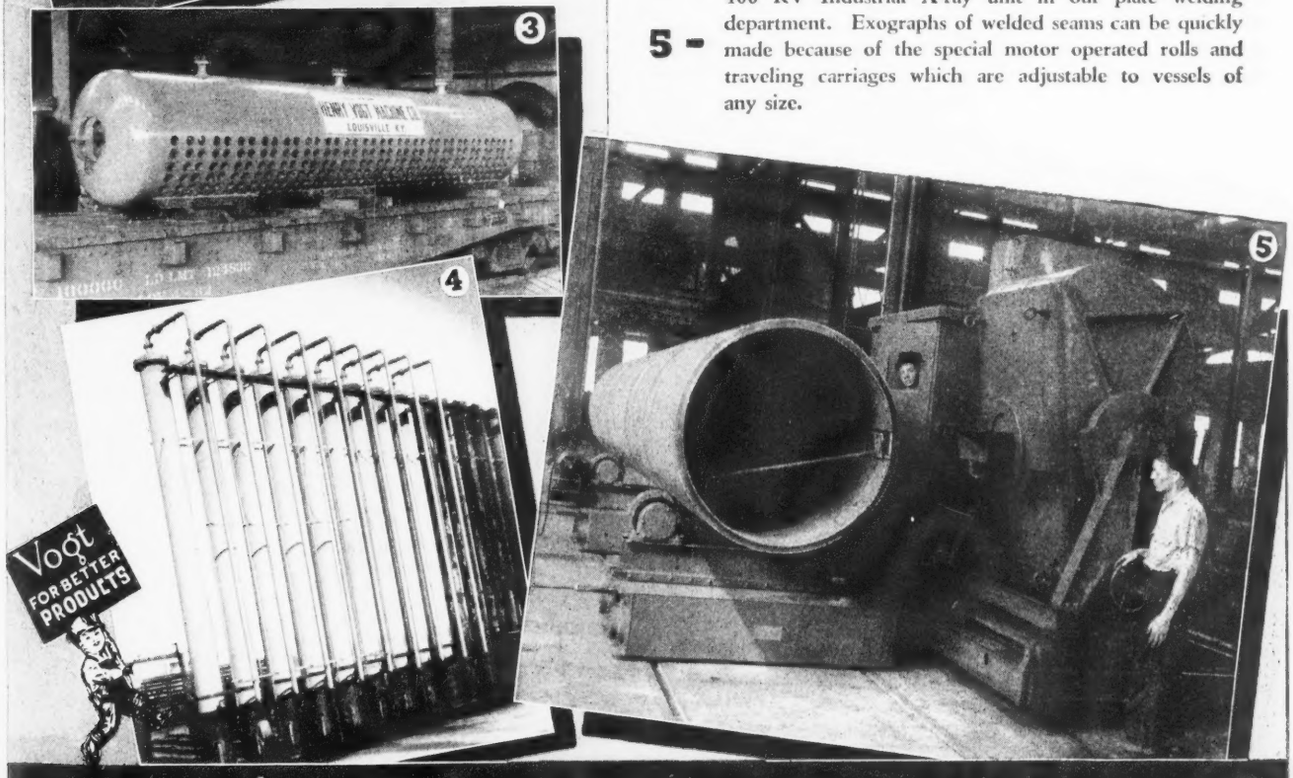
1 - 4′—0″ dia. x 7′—6″ dia. x 82′—5″ high Stabilizer Tower for a Texas Refinery. Fabricated to A.P.I.-A.S.M.E. Code, stress relieved and X-rayed. 250# working pressure.

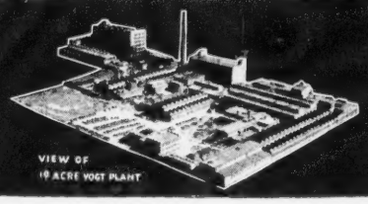
2 - Heat Exchangers, for an Eastern Refinery, on the testing floor. Units have fusion welded Monel Metal shells and were built to customer's specifications.

3 - 48″ dia. x 22′—6″ long mud drum for a Vogt Water Tube Boiler designed to operate at 450# S.W.P. Fusion welded to A.S.M.E. Boiler Code.

4 - Battery of Absorption Columns in a Western Refinery. Units are 33″ dia. x 41′—0″ high and were stress relieved after welding.

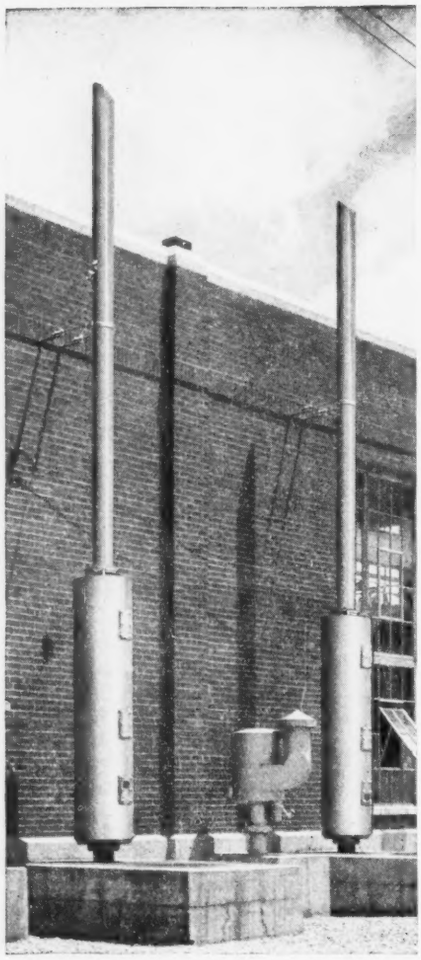
5 - 400 KV Industrial X-ray unit in our plate welding department. Exographs of welded seams can be quickly made because of the special motor operated rolls and traveling carriages which are adjustable to vessels of any size.





HENRY VOGT MACHINE CO.
Incorporated
LOUISVILLE, KENTUCKY
BRANCH OFFICES: NEW YORK · PHILADELPHIA · CLEVELAND · CHICAGO · DALLAS

ODESSA POWER PLANT SILENCED BY MAXIMS



• The installation above shows Maxim Silencers installed on the exhaust of two 415 HP Worthington Diesels at the new Odessa, Missouri power plant . . . Let MAXIMS solve YOUR silencing problems . . . send coupon for details.

THE MAXIM SILENCER COMPANY
92 Homestead Ave., Hartford, Conn.

Please send details on your silencers for EXHAUST ☐ for COMPRESSOR INTAKE ☐ for STEAM BLOW-OFF ☐

Name.....

Company.....

Address.....

City.....State.....

since 1907, and known throughout the country as an authority on fire prevention, died at Lynn, Mass., October 31.

F R Lowell, manager of engine sales, National Supply Co, was a casualty in an airplane wreck which occurred October 30, 1941.

Frank C Reeder, field service engineer of the Fulton Sylphon Co, Knoxville, Tenn., passed on November 12. He was well-known as an outstanding

Frank Reeder

practical authority on temperature control. He has been with the Fulton Sylphon Co for 34 years.

D C Prentice, former power company head, died November 11 at his home in LeRoy, N. Y. In early life he was associated with his father in the LeRoy Power & Milling Co and the LeRoy Hydraulic Electric Gas Co, becoming head of both firms. Both properties later were absorbed by the Niagara, Lockport & Ontario Power Co.

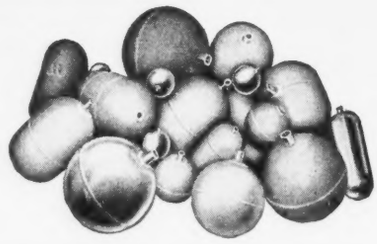
John J Graham, 60, vice president and a director of the Hartford Steam Boiler Inspection & Insurance Co, died as the result of a heart attack on November 17.

Julian Roe, for many years western sales manager of the Crocker-Wheeler Electric Mfg Co, died at his home in Chicago on November 24. He was one of the pioneers in the motor and generator field. He joined the Crocker-Wheeler organization in 1893.

Frank D Comerford, 48, president of the Boston Edison Co, died November 24. At the age of 34, in 1927, he became president of the New England Power Association, serving until 1932, when he was made president of Boston Edison. For several years he was a trustee of Edison Electrical Institute.

Belvin T Williston, 88, a retired steam engineer formerly connected with

NICHOLSON



HIGH-PRESSURE WELDED FLOATS

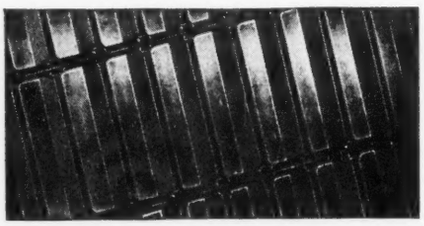
Available for all applications—for steam pressures up to 1500 lbs. and hydrostatic pressures up to 2500 lbs.—for corrosive and non-corrosive service.

Made in spherical and eliptical shapes and in sizes from 2½" to 14" diameter. High in tensile strength and offer great resistance to external pressure. Special sizes and shapes available to order, and also cadmium, nickel or copper plated. Fully described in Bulletin No. 339.

OTHER PRODUCTS — NICHOLSON Industrial Steam Traps, Piston and Weight Operated Traps, Flexible Couplings, Expanding Mandrels, Arbor Presses, Compression Shaft Couplings, Steam Eliminators and Separators, Compressed Air Traps.

W. H. NICHOLSON & COMPANY
125 OREGON STREET
WILKES-BARRE PENNSYLVANIA, U.S.A.

BATESGRATES
FILLET WELD
Open Steel Floor Grating



Easily maintained - - -
NO CRACKS, JOINTS, CREVICES

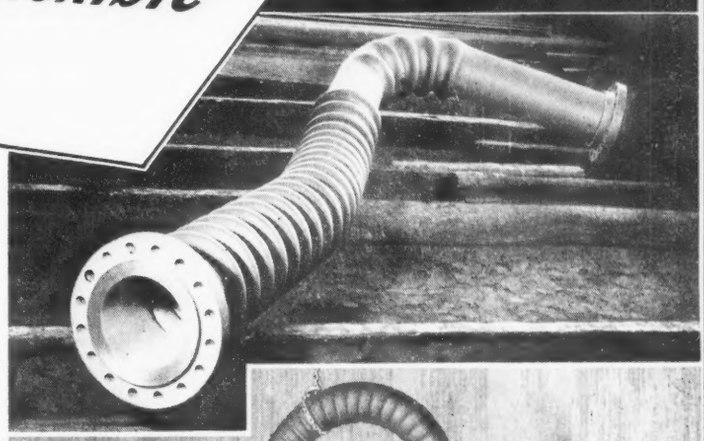
Bategrates are self-cleaning because of peaked, non-skid cross bar. They have no grooves or rough burned metal to catch grease or dirt. Safe traction. Batesgrates are strictly one piece—no cuts, slots, or punching. Made from Hexagon Shaped Hot Rolled Steel Bars with smoother, larger, much stronger welds. Send today for engineering Catalog No. 937.

When you need grates
SPECIFY BATES
for long-time economy

WALTER BATES CO.
208 S. LaSalle St. Chicago, Ill.

LET PIPING *Flex* ITS SINEWS TO REDUCE STRESS—SAVE SPACE

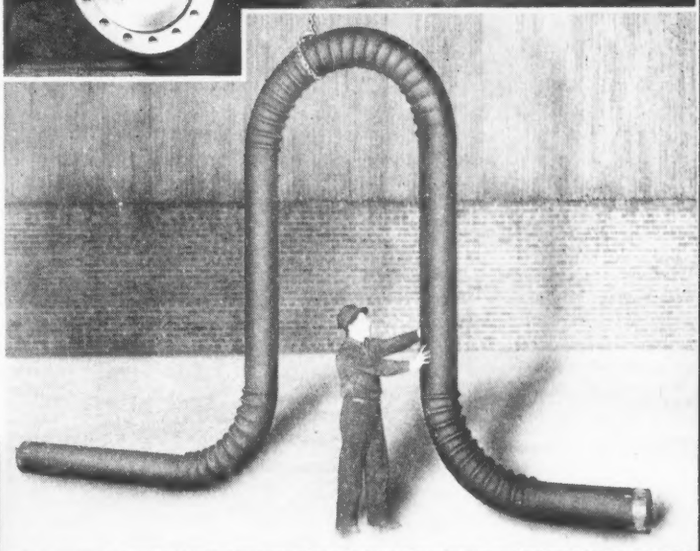
USE PITTSBURGH PIPING Creased Bends and Super-Flexible Corrugated Tangents

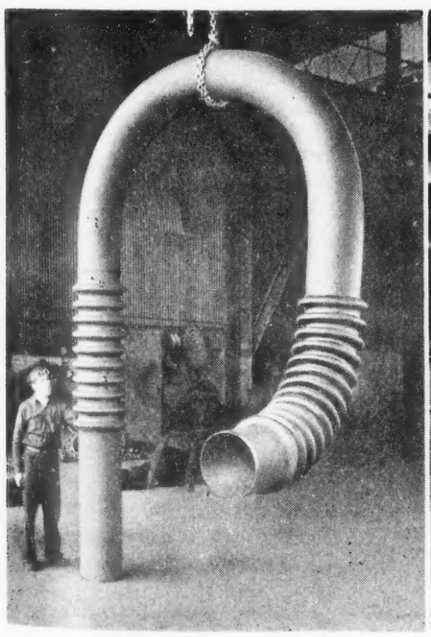


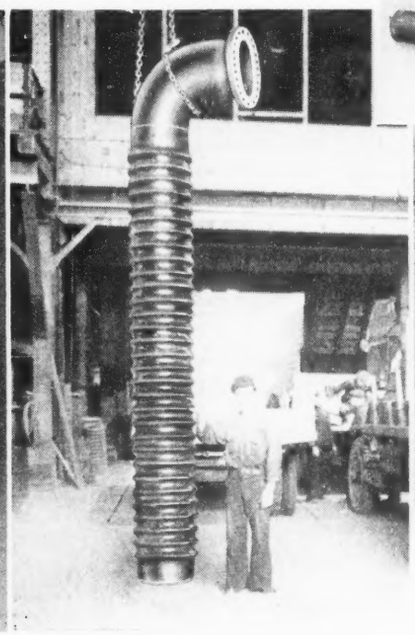
BY the proper use of creased bends and corrugated straight pipe sections, a piping system's resistance to movements caused by thermal expansion will be materially reduced. This greatly increased flexibility inherent in this type of piping makes possible . . . the use of shorter lines without excessive stresses and end reactions against equipment . . . short radius bends . . . more convenient location of valves . . . and all-round more compact and efficient piping system.

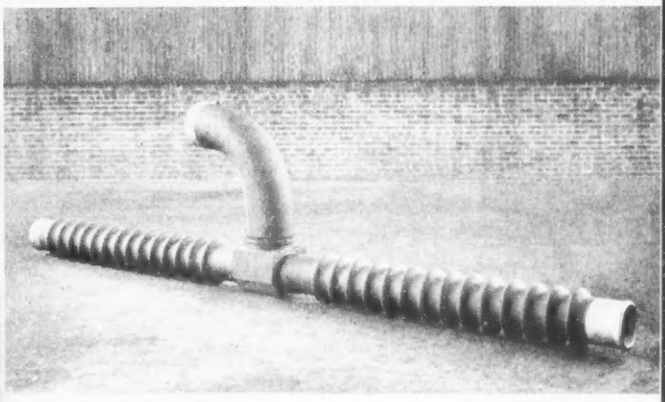
Due to the flexing of the corrugations, a straight length of corrugated pipe will offer only 1/5 as much resistance to bending as a straight pipe of the same length and size.

As the illustrations on this page show, Pittsburgh Piping Creased and Corrugated construction is applicable to practically any piping design. Our engineers will be glad to show you how it can be used to advantage in your next piping.







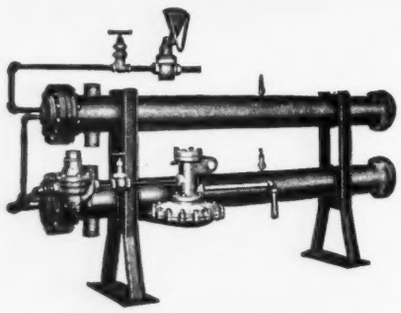


PITTSBURGH PIPING & EQUIPMENT CO.
10 FORTY-THIRD STREET PITTSBURGH, PA.

Woolworth Bldg., New York Occidental Bldg., Indianapolis Peoples Gas Bldg., Chicago Union Guardian Bldg., Detroit
Public Sq. Bldg., Cleveland 10 High St., Boston Liberty Life Bldg., Charlotte 525 Market St., San Francisco

Pittsburgh Piping

if BOILERS
were BOMBERS



HENSZEY

CONTINUOUS BLOWDOWN

would be standard equipment!

Uninterrupted service is required today, whether it be from bombers or from boilers.

A Henszey Continuous Blowdown system in your plant will hold boiler repairs and shutdowns at a minimum—will make your equipment last longer—will make valves, traps, etc. function perfectly—will produce more power with less fuel consumption.

The Henszey Continuous Blowdown system does all this by holding the boiler water concentration below a "safe" point—does it continuously, automatically—and without heat loss. Priming, foaming, carryover, and other troubles due to high boiler water concentrations are prevented. And with simple water treatment boilers are kept free of scale.

FOR YOUR FILE

Send for a copy of our bulletin: Complete Automatic Control of Boiler Water Concentration without Heat Loss!

HENSZEY COMPANY
Dept. DI Watertown, Wis.

HENSZEY
POWER PLANT SPECIALTIES

the Hancock Inspirator Co, Boston, Mass., died in Somerville, Mass., November 19.

STUART J MARBLE, manager of the Industrial Dept, New York district office of Revere Copper & Brass, Inc, passed away November 24. Following graduation from high school he entered the employ of Chase Brass & Copper Co. In 1912 he became affiliated with the Rome Brass & Copper Co, which in 1928 was consolidated with five other companies to form what ultimately became Revere Copper & Brass, Inc.

H G VOGEL, 78, a pioneer in development of automatic sprinkler systems and president of H G Vogel Co, New York, died at Gilford, N. H., November 20.

WILLIAM M WINTERROWD, 57, vice president in charge of operations and a member of the board of the Baldwin Locomotive Works, died on December 7, as a result of injuries received in an automobile accident. Mr Winterrowd was only recently elected a vice president of the American Society of Mechanical Engineers at the annual meeting.

JOHN C CARTER, office supervisor of the power and heating bureau of the Buffalo Niagara Electric Corp, died November 19 after a brief illness. He was 53 years old.

PERSONALS

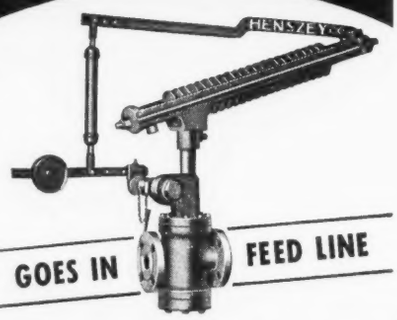
W J THOMAS, for nine years with the process Equipment Div, Babcock & Wilcox Co, Barberton, Ohio, has been transferred to the executive department sales offices of the Babcock & Wilcox Tube Co at Beaver Falls, Pa.

ROBERT M KALB, former research engineer of the Bell Telephone Laboratory of New York, has been appointed assistant chief engineer of Kellogg Switchboard and Supply Co, Chicago.

C A BUTCHER, former eastern district service manager of the Westinghouse Electric and Mfg Co, has been appointed assistant manager of the District Manufacturing and Repair Department. Mr Butcher has been with the company since 1917, starting as a salesman in the Railway Div.

CARL A SALMONSEN, assistant to the works manager, General Electric Co, Lynn, Mass., has been placed in charge of manufacturing activities in the Tur-

HENSZEY
BOILER FEED
REGULATORS



The Henszey Boiler Feed Regulator controls boiler water levels continuously and accurately under *all* load conditions!

These simple, compact, self-contained units go right in the feed line and require no additional structural support. They are as easy to install as a simple gate or globe valve. Once installed and set for operation no further attention is necessary — nothing to get out of order—nothing to reset.

Send for latest Bulletin containing full details.

HENSZEY COMPANY
Dept. D1—Watertown, Wis.

ROCKWELL'S complete line of Blast Gates includes all types: Slide, Kwikleen, Wafer, and Butterfly, in sizes up to 48". They are quick and easy to operate—strong, light, and durable. They can be supplied in monel, bronze, stainless steel and other alloys to meet individual requirements.

Write for catalog 4020, W. S. Rockwell Co., 50 Church Street, New York.

★ Rockwell ★
BLAST GATES

Blazing New Trails FOR PEACE and PLENTY

At the southern tip of Texas is soil said by some to be the richest in America. Today thousands of acres are producing fine garden truck -- beans, onions, carrots, beets, potatoes. Other thousands are in citrus orchards, with an annual crop already of more than 11 million boxes.

Prior to the coming of modern steel in this section--the first standard gauge railroad in 1904--this valley was desolate, thorny jungle, incapable of sustaining human life. And only since the advent of modern machinery is there real progress in making it productive for man. Now for example, with this machine, built largely of Youngstown steel, mesquite, ebony and brush are being cleared off at the speed of one acre an hour -- 24 hours a day!

For many years, heavy equipment companies have found Youngstown steels ideally suited for making their products. For the peacetime needs of America's future, as well as for defense of the present, Youngstown is always ready to serve.

25-29D

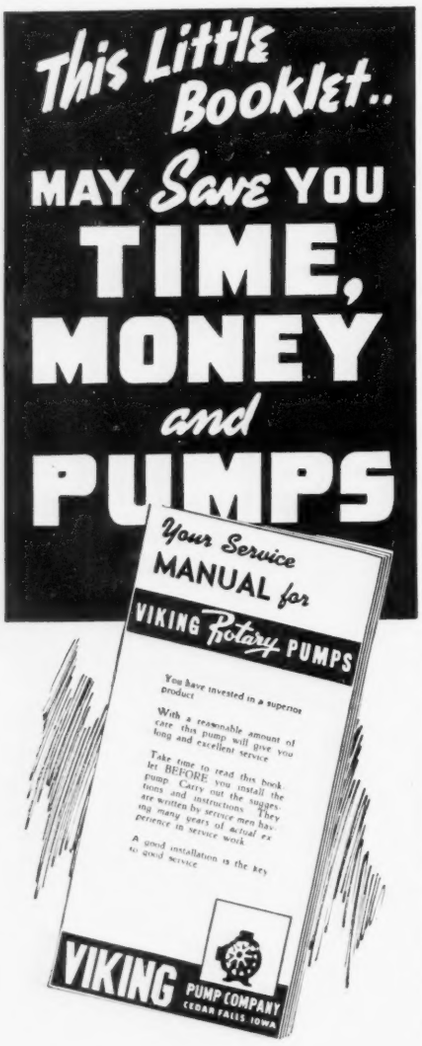
QUALITY TRADE MARK YOUNGSTOWN SERVICE

Youngstown products include Pipe and Tubular Products - Sheets - Plates - Conduit - Bars - Tin Plate - Rods - Wire - Nails - Tie Plates and Spikes

THE YOUNGSTOWN SHEET AND TUBE COMPANY

Manufacturers of Carbon, Alloy and Yoloy Steels

General Offices - YOUNGSTOWN, OHIO


This Little Booklet..
MAY Save YOU
TIME, MONEY and PUMPS
Your Service MANUAL for
VIKING Rotary PUMPS
You have invested in a superior product
With a reasonable amount of care this pump will give you long and excellent service
Take time to read this book-let BEFORE you install the pump. Carry out the sugges-tions and instructions. They are written by service men hav-ing many years of actual ex-perience in service work.
A good installation is the key to good service
VIKING PUMP COMPANY
CEDAR FALLS IOWA

When pumps are hard to get it's wise to take good care of the ones you have. The Viking Service Manual is a handy, illustrated booklet that tells you how to get utmost performance out of Viking Rotary Pumps. It explains and pictures correct installation . . . shows you how pumping efficiency may be stepped up . . . suggests how some repairs and replacements may be avoided.

Gain valuable help in your pumping operations by consulting the Viking Service Manual. It is offered to you FREE. Your request for a copy will be filled by return mail.

VIKING
PUMP COMPANY
CEDAR FALLS, IOWA

bine, Generator and Gear Departments there. He will continue in charge of supercharger production in the River and Everett Works.

FRANK W ROWE, general purchasing agent, Johns Manville Corp, is among the first to retire under the company's new retirement plan. Mr Rowe, who is 72, joined Johns Manville in 1914 after serving as a purchasing agent for the General Electric Co.

CHARLES C WALLACE has been named works manager of the Westinghouse Electric Elevator Co, Jersey City, N. J. Mr Wallace joined the elevator company in 1928 and has served at various times as a design engineer, chief inspector and general foreman. For the past year he has been general foreman of the Jersey City plant.

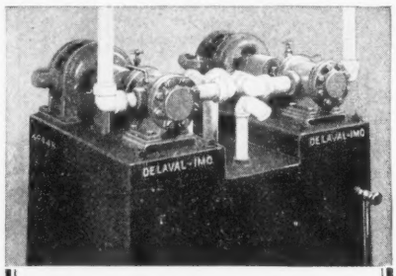
HOWARD W LEITCH, vice-president of Consolidated Edison Co of New York, retired October 31. Mr Leitch was hired by the electric company as a brushman 46 years ago. He was made vice-president in charge of electrical operations in 1938, serving until December 1940. Since then he has worked as consultant on special assignments. Mr Leitch took charge of the Sherman Creek and Hell Gate Stations of the system during their construction and built up the plant organizations.

EDMOND D MONK has been made manager of power transformer sales for General Electric's Central Station Dept at Pittsfield. Mr Monk succeeds the late L L Biche, whom he had assisted since 1926.

WILLIAM H SULLIVAN, steam engineer for the Westinghouse Electric & Mfg Co at Philadelphia, Pa. for the past five years, has been named steam engineer of the company's Pacific Coast district. In his new post, Mr Sullivan will be active upon all negotiations involving steam turbines for land and marine use. His territory as a consultant will comprise the entire Pacific Coast territory of the company.

J H WATTERS on November 1 became president of Union Asbestos and Rubber Co, succeeding L L Cohen, who was elected chairman of the board. Mr Watters was formerly the general manager of the Marion Steam Shovel Co, Marion, Ohio.

DR CHARLES E LUCKE has been appointed consultant of Chemical Construction Corp, New York. Dr Lucke, who retired this year as head of the



DE LAVAL-IMO OIL PUMPS
on Combustion Control

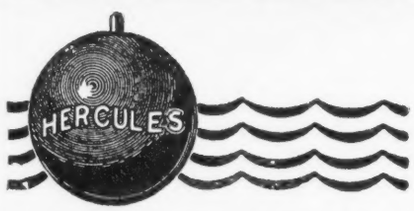
Hydraulic pressure oil to the combustion controls of the 2400 pound boilers in the Twin Branch Power Station of the Indiana & Michigan Electric Co. is supplied by these two De Laval-IMO oil pumps. This Station also has two other De Laval-IMOs for oil burner service, as well as De Laval centrifugal condensate, booster and hot well pumps.

Write for Publication I-89.

IMO I MOVE OIL

IMO PUMP DIVISION
of the
De Laval Steam Turbine Co.
Trenton, New Jersey

HERCULES
Seamless Copper
FLOATS



GUARANTEED TO STAND UP!

Every Hercules Float carries our guarantee to stand up under 350 lbs. working pressure and 500 degrees temperature.

Fabricated of seamless copper under our special spinning process. Hercules Floats are uniform in thickness and high in mechanical strength.

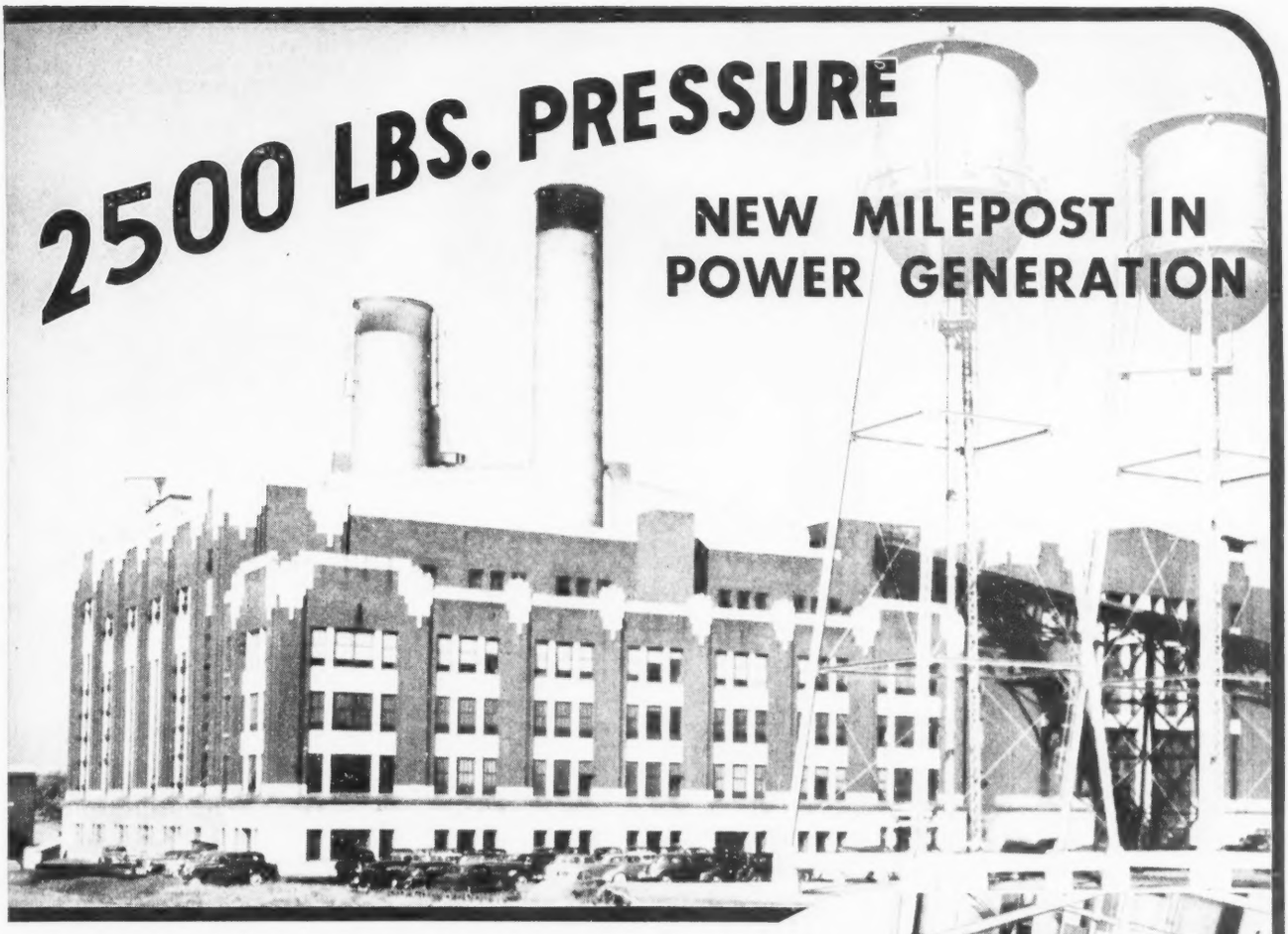
You can depend on Hercules for floats—in standard shapes up to 10 in. and in special types to your specifications—to give long, dependable, economical service.

Insure care-free maintenance of water level in your heaters, tanks, reservoirs and other equipment by specifying "HERCULES."

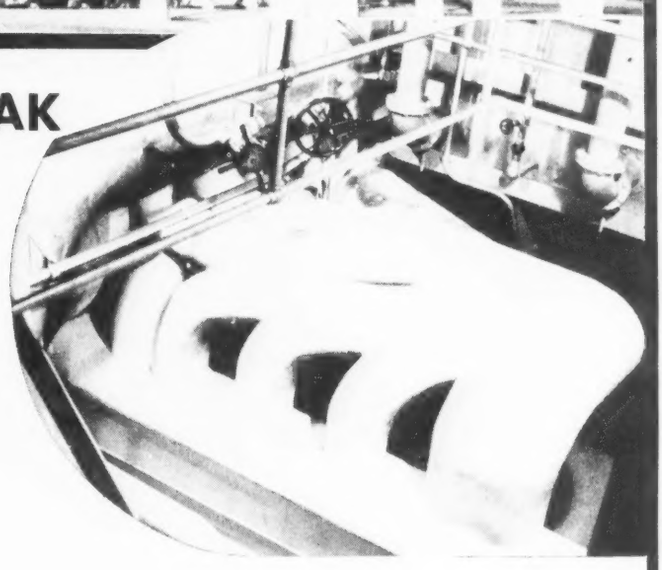
HERCULES FLOAT WORKS
200 Franklin St.
SPRINGFIELD, MASS.

2500 LBS. PRESSURE

NEW MILEPOST IN POWER GENERATION



NEW PERFORMANCE PEAK *for* Carey HEAT INSULATIONS



The new 76,500-KW extension at the Twin Branch plant of the Indiana & Michigan Electric Company, at Mishawaka, Indiana, with boiler and turbine pressure of 2500 lbs., at 940°F, is the first installation in America at that pressure and temperature —an economic development of first importance in central station engineering.

Naturally, such pressure and temperature demanded heavy use of insulations of dependable and unfailing performance. The fact that CAREY Insulations were selected for this epoch-making job is outstanding evidence of their favor with engineers for power plant duty.

Through constant research and experience, CAREY Heat Insulations have become a definitely known factor in retarding heat transmission. Regardless of how severe the demands, results may be calculated in advance with mathematical precision.

A nationwide organization is ready to help you solve your insulation problems. Write for details—address Dept. 16.

THE PHILIP CAREY MFG. COMPANY • Lockland, Cincinnati, Ohio
Dependable Products Since 1873
IN CANADA: THE PHILIP CAREY COMPANY, LTD. Office and Factory: LENNOXVILLE, P. Q.

LONGER LIFE FOR YOUR FURNACE LININGS

Adamant's superior bonding strength (800 lbs. per sq. in. at room temperature . . . 1270 lbs. per sq. in. at 2600° F.) has been proved—by impartial laboratory tests.

Actually welding the bricks together, Adamant insures maximum life of furnace walls . . . and by the same token, insures savings in time, labor, materials!

You can use such savings! . . . write today for details.

ADAMANT
FIRE BRICK CEMENT

BOTFIELD
REFRACTORIES COMPANY

784 S. Swanson St., Philadelphia, Pa.
In Canada, Canadian Botfield Refractories Co., Ltd., 171 Eastern Avenue, Toronto.

Specify

Fig. 1510 Cutout Section shows locking nut in place

where

VIBRATION
is the problem

Pat'd.

CAN'T SHAKE LOOSE! — "Unshako" is made with a simple, built-in, self-energizing locking ring that works on the brake band principle . . . locks in a sure, never-failing grip that makes permanent tightness a certainty. "Unshako" is easy to apply or remove and you can use it repeatedly! For free descriptive bulletin, write STANDARD PRESSED STEEL CO., BOX 577, JENKINTOWN, PA.

UNSHAKO
Reg. U. S. Pat. Off.
SELF-LOCKING NUT

Department of Mechanical Engineering, Columbia University, is widely known as an outstanding authority on heat and power.

JOSEPH A SULLIVAN has been named advertising manager of Chicago Pneumatic Tool Co, New York, N. Y. Mr Sullivan has been with the organization since 1928.

HARVEY L WILLIAMS, JR has joined the Hawkins-Hamilton Co, Richmond, Va. as sales engineer. His current responsibilities with the company include sales engineering work in the Richmond territory for Cochrane Corp, Hays Corp, Nash Engineering, Northern Equipment, Terry Steam Turbine, Andale Co, Detroit Stoker Co, Micro-Westco and Crosby Gage and Valve.

T I PHILLIPS has been elected a vice-president of the Westinghouse Electric & Mfg Co. Mr Phillips started with the company as a toolmaker, in 1915. He has been assistant to the president since February 14, 1941.

HERMAN W STEINKRAUS, vice-president and a director of Bridgeport Brass Co since 1928, has been elected general manager of the company. Mr Steinkraus became general sales manager of the company following a merger in June 1928. A few months later, he was elected vice-president in charge of sales and a director, which positions he held until January 1941.

J T P KENYON, for the last 15 years manager of mechanical equipment purchases of the Consolidated Edison Co of New York, has been retired after 40 years of service. He has been succeeded by DAVID WILLIAMS, who has been with the company for 22 years. For the past 15 years he has been in charge of cable and electrical-equipment purchases.

CHARLES E HOLLETT, 63, superintendent of the Power Dept, Sinclair Refining Co, Wellsville, New York, died at his home there December 1. Mr Hollett became associated with the company in 1918 and in 1928 went to Wellsville to become power plant superintendent.

ROBERT J HOWISON has been appointed sales manager of the Automotive Div Morse Chain Co, Detroit, Mich. Mr Howison has been active in the sales engineering and application of timing chains for internal combustion engines, as well as general industrial silent and roller-chain applications.

ENGINEERS... ATTENTION!

NOW IS THE TIME
TO ORDER REPLACEMENTS
ERNST
PRECISION GAGE GLASSES
for high pressure and temperature and
ALL SIZES
FLAT GAGE GLASSES
— CLEAR AND REFLEX —
Nonhardening and Nonsoftening
GAGE GLASS GASKETS
that will fit exactly

THEY WILL NOT BLOW OUT

STANDARD high pressure—square cut—STEAM GASKETS—over 100 different sizes.

LIP-MOLD pattern Expansion type GASKETS

SPECIAL OIL RESISTANT GASKETS

Send for Gage Glass and Gasket Chart

ERNST WATER COLUMN & GAGE CO.
RUBBER & GLASS DIVISION
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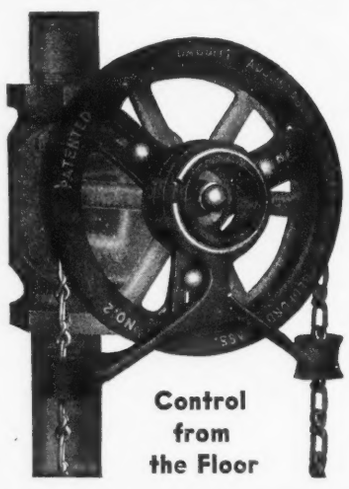
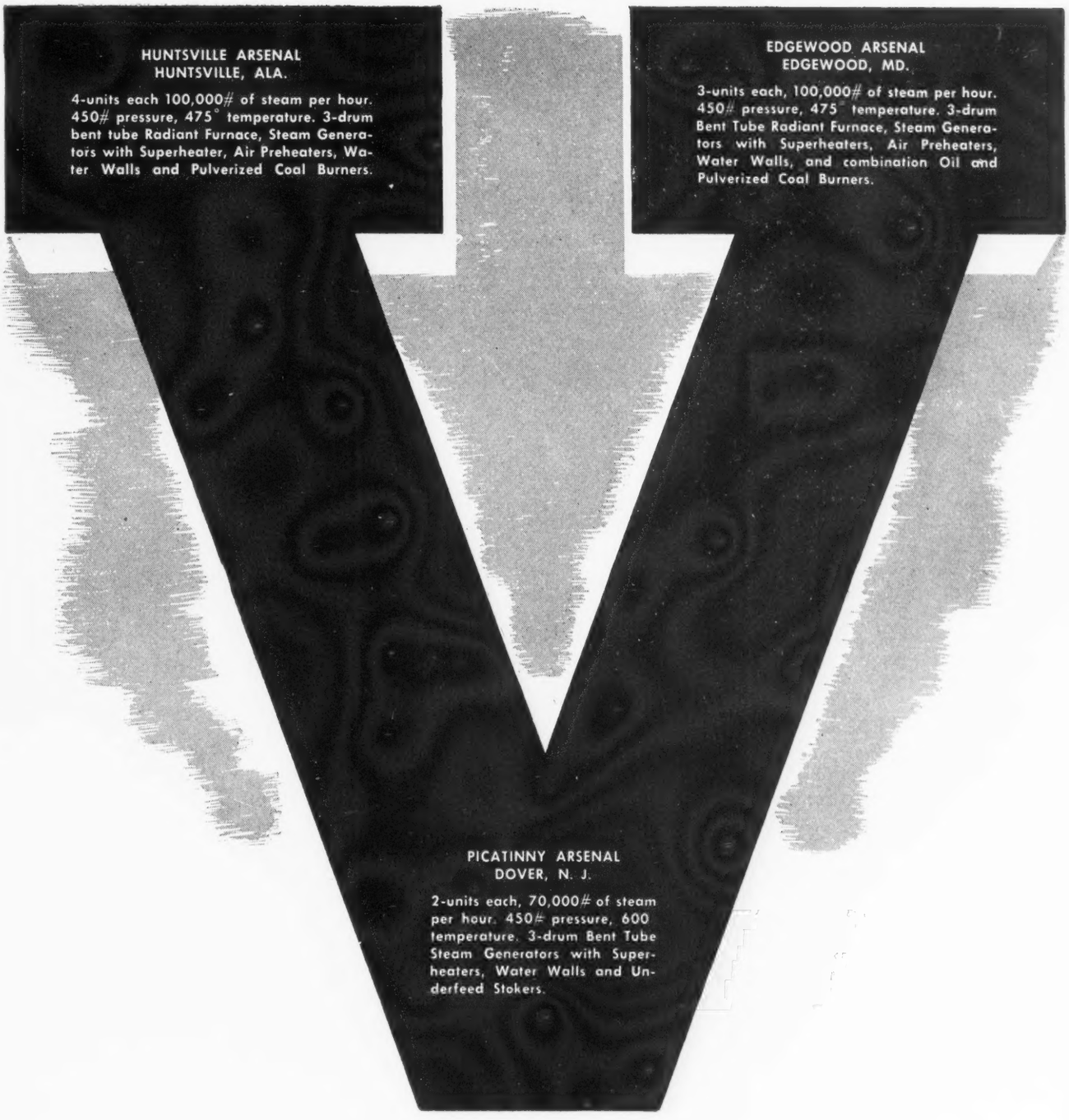
Make Your Overhead Valves SAFE And Easy to Reach---



Control from the Floor

With the Babbitt Rim for Valves you eliminate danger and banish the step-ladder. You can now place your valves wherever they come economically and conveniently. They fit any valve. Let us tell you more about them. Write today.

BABBITT STEAM SPECIALTY CO.
New Bedford, Mass.


HUNTSVILLE ARSENAL
HUNTSVILLE, ALA.
4-units each 100,000# of steam per hour. 450# pressure, 475° temperature. 3-drum bent tube Radiant Furnace, Steam Generators with Superheater, Air Preheaters, Water Walls and Pulverized Coal Burners.
EDGEWOOD ARSENAL
EDGEWOOD, MD.
3-units each, 100,000# of steam per hour. 450# pressure, 475° temperature. 3-drum Bent Tube Radiant Furnace, Steam Generators with Superheaters, Air Preheaters, Water Walls, and combination Oil and Pulverized Coal Burners.
PICATINNY ARSENAL
DOVER, N. J.
2-units each, 70,000# of steam per hour. 450# pressure, 600 temperature. 3-drum Bent Tube Steam Generators with Superheaters, Water Walls and Underfeed Stokers.

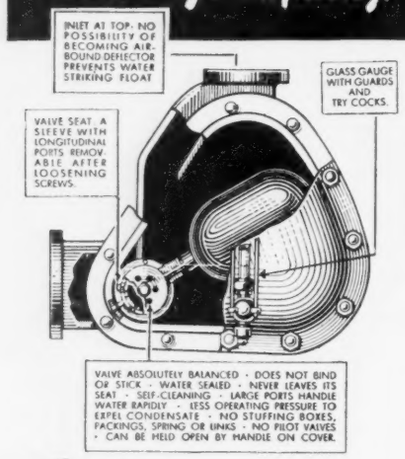
The contract for each of these installations calls for the furnishing of equipment, complete erection and putting into operation by EDGE MOOR.

EDGE MOOR IRON WORKS, INC. 30 Rockefeller Plaza, New York, N. Y.

Kansas City Chicago Detroit Richmond, Va.

In Canada UNITED STEEL CORPORATION, LTD. Toronto Montreal

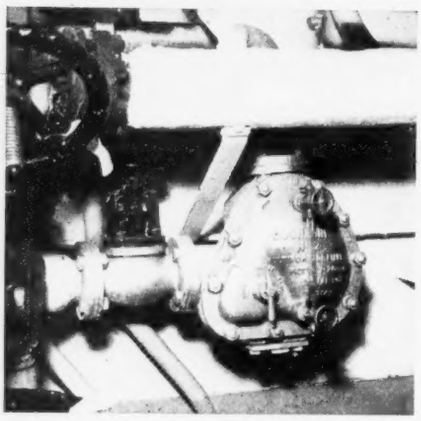
Extraordinary Discharge Capacity


INLET AT TOP. NO POSSIBILITY OF BECOMING AIR-BOUND. DEFLECTOR PREVENTS WATER STRIKING FLOAT
GLASS GAUGE WITH GUARDS AND TRY COCKS.
VALVE SEAT A SLEEVE WITH LONGITUDINAL PORTS REMOVABLE AFTER LOOSENING SCREWS.
VALVE ABSOLUTELY BALANCED · DOES NOT BIND OR STICK · WATER SEALED · NEVER LEAVES ITS SEAT · SELF-CLEANING · LARGE PORTS HANDLE WATER RAPIDLY · LESS OPERATING PRESSURE TO EXPEL CONDENSATE · NO STUFFING BOXES, PACKINGS, SPRING OR LINKS · NO PILOT VALVES · CAN BE HELD OPEN BY HANDLE ON COVER.

Cochrane

MULTIPORT DRAINER

for *Quick* Drainage of *Large Quantities* of Condensate . . .



THE "Multiport" principle on which the Cochrane Drainer operates is that of a hollow cylindrical valve with a number of longitudinal ports which register with similar ports in the valve seat when the float is in the raised position. The combined capacities of these ports is unusually large, which accounts for the valve's extraordinary discharge capacity. For complete details mail this coupon.

COCHRANE

Cochrane Corp., 3106 N. 17th St., Phila., Pa.
Please send me copies of your publications on Condensate Drainage

Name.....

Firm.....

Address.....

City.....State.....

BUSINESS ITEMS

YARNALL-WARING Co, Philadelphia, announces following personnel changes in sales organization: C Wilson Jr, formerly of the New York office, has been appointed district manager of the Pittsburgh-Cleveland territory and C N Maxfield, district manager of Detroit territory. Bernard R Bristol and Charles H Grosjean have joined the New York sales staff; A E Robinson, the Chicago sales office and A L Aicher, the Philadelphia sales office.

CUTLER HAMMER Co, Milwaukee, Wis, announces the appointment of E C Bolton as manager of the Cincinnati District sales office. A native of West Virginia, Mr Bolton has had his headquarters in Chicago for the past 16 years.

CARDOX CORP, Chicago, Ill., has opened a New York office at 233 Broadway. Harry Ensminger has been placed in charge of the office.

YOUNG RADIATOR Co, Racine, Wis, announces appointment of George J Haislmaier as sales manager of the Contract Products Div. Robert Grant has also joined the company in a production and managerial capacity.

SOUTH BEND LATHE WORKS, Dept 5P, South Bend, Ind. has produced a series of 16-mm sound motion picture films based on the book, "How to Run a Lathe." These films, in full color, have been produced to speed up training of lathe operators. The films are about 800 ft long with a showing time of about 20 minutes. Additional information can be obtained from the above company.

Brown, Boveri Celebrates Fifty Years of Pioneering

By PHIL SWAIN, *Editor*

Completely surrounded by warring nations, little Switzerland is one of the few remaining oases of peace in Europe. When I visited six European nations in 1936, none impressed me more than Switzerland. Here were sensible people—intelligent, highly industrialized, hard-working—always intensely patriotic, yet always minding their own business. At that time it was my particular privilege to study the plant and operations of Brown, Boveri & Co (in Baden)—a company long associated with pioneering ventures in engineering.

Brown, Boveri completed its first half

Now Ready!

The engineers' handbook that takes the place of a whole library—

You have in this book what engineers have asked for time and time again—one handbook that embodies the most fundamental and frequently useful data of all engineering—1120 pages of practical, up-to-date information, reference data, specific facts, definite methods, essential formulas, covering civil engineering, mechanical engineering, and electrical engineering. You secure in this handbook the engineering information you constantly want in the form in which you want it and can use it—one handy book, clear, concise, complete, convenient.

New 2nd Edition

O'Rourke's

GENERAL ENGINEERING HANDBOOK

By CHARLES E. O'ROURKE, Editor-in-Chief, and 25 specialists

200 pages larger than the first edition, but priced the same, $4.00

Now, besides the most fundamentally useful data of your own field, you can get similar material in other fields in which problems may come up—presented in understandable form—all in one compact volume, handy for field, shop, and desk use. New edition 20% larger, with better emphasis on basic material. Fully revised and up-to-date.

SEE IT FOR 10 DAYS ON APPROVAL

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The real meat of several handbooks in one

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Send me O'Rourke's General Engineering Handbook for 10 days' examination on approval. In 10 days I will send $4.00, plus few cents postage, or return book postpaid. (Postage paid on orders accompanied by remittance.)

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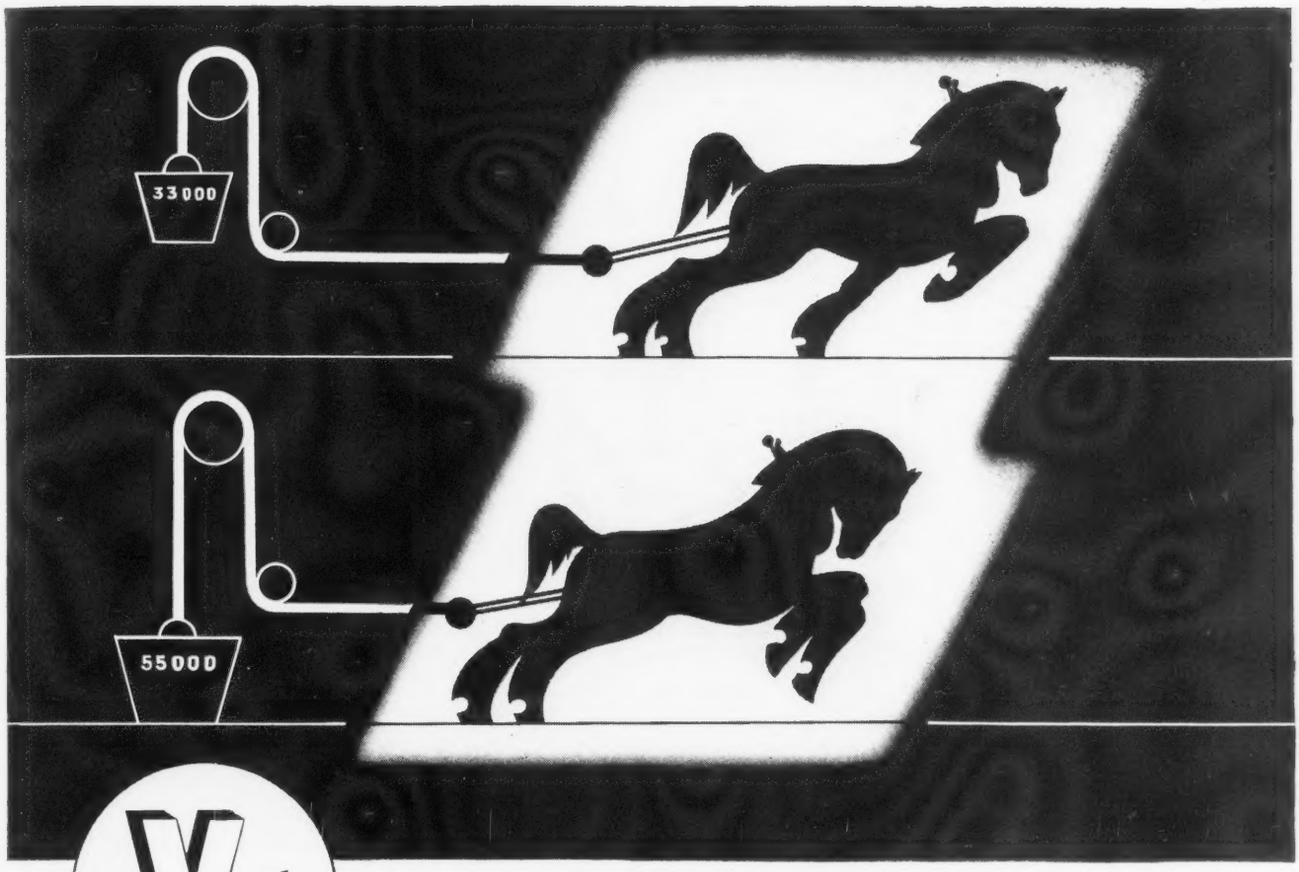


MULTIPLE V-BELT DRIVE ASS'N

THE DOMINANT DRIVE OF INDUSTRY

TRADE MARK

The use of this emblem by an association member in connection with Multiple V-Belt Drives is your assurance of mechanical excellence — the result of cooperative engineering, research and experience.

how the "service factor" eliminates underguessing the required h. p.

During the early period of Multiple V-Belt Drive development it became apparent that somewhere in the selection formula, some important factor was missing. The belts on some installations wore out prematurely, although the drive theoretically satisfied all the mathematical requirements. In other cases where the specifications seemed identical, the drive delivered unusually long service. . . . Endless field surveys and the comparison of findings by members of the Multiple V-Belt Drive Association brought the "vagrant variable" to light. The difference lay in the characteristics of the prime mover and the nature of the load. It was discovered that some types of drives required up to double the number of belts for the same drive horsepower. . . . Results of thousands of check-ups, tabulated to include every conceivable combination, became today's "Service Factors". These "Service Factors" eliminate underguessing the required h.p. of the belts and assure long and uninterrupted service life.

MULTIPLE-V-BELT DRIVE ASSOCIATION
140 SOUTH DEARBORN STREET • CHICAGO

1/4 to 50 tons

large or small—special or routine

Regardless of whether your work demands special application or routine handling—whether it be 500 pounds or 40 tons—whether an electric hoist, a hand-operated high-speed hoist, traveling crane, or monorail trolley—Wright engineers know how to solve your problem *economically*.

Here are three things you get in every **WRIGHT HOIST:**

1. **SAFETY.** The load chain has a safety factor of 7 to 1. The bottom hook which is drop forged from special steel, acts as a safety governor, in that it gives warning of overload by slowly opening. These hooks possessing an unusual degree of ductility will straighten out before any part of the hoist is damaged, plus acting as a warning to the operator.

2. **EFFICIENCY.** **WRIGHT HOISTS** are fast, smooth and positive in action because of scientifically engineered design.

3. **DEPENDABILITY.** **WRIGHT HOISTS'** rugged and precision design assures year-in and year-out durability and the very minimum of maintenance cost.

Let Wright engineer your hoisting and crane problems. Work through the Wright distributor in your city. You'll find him listed in the classified telephone book.

WRIGHT MANUFACTURING DIVISION
YORK • PENNSYLVANIA

In Business for Your Safety

AMERICAN CHAIN & CABLE COMPANY, Inc. BRIDGEPORT CONNECTICUT

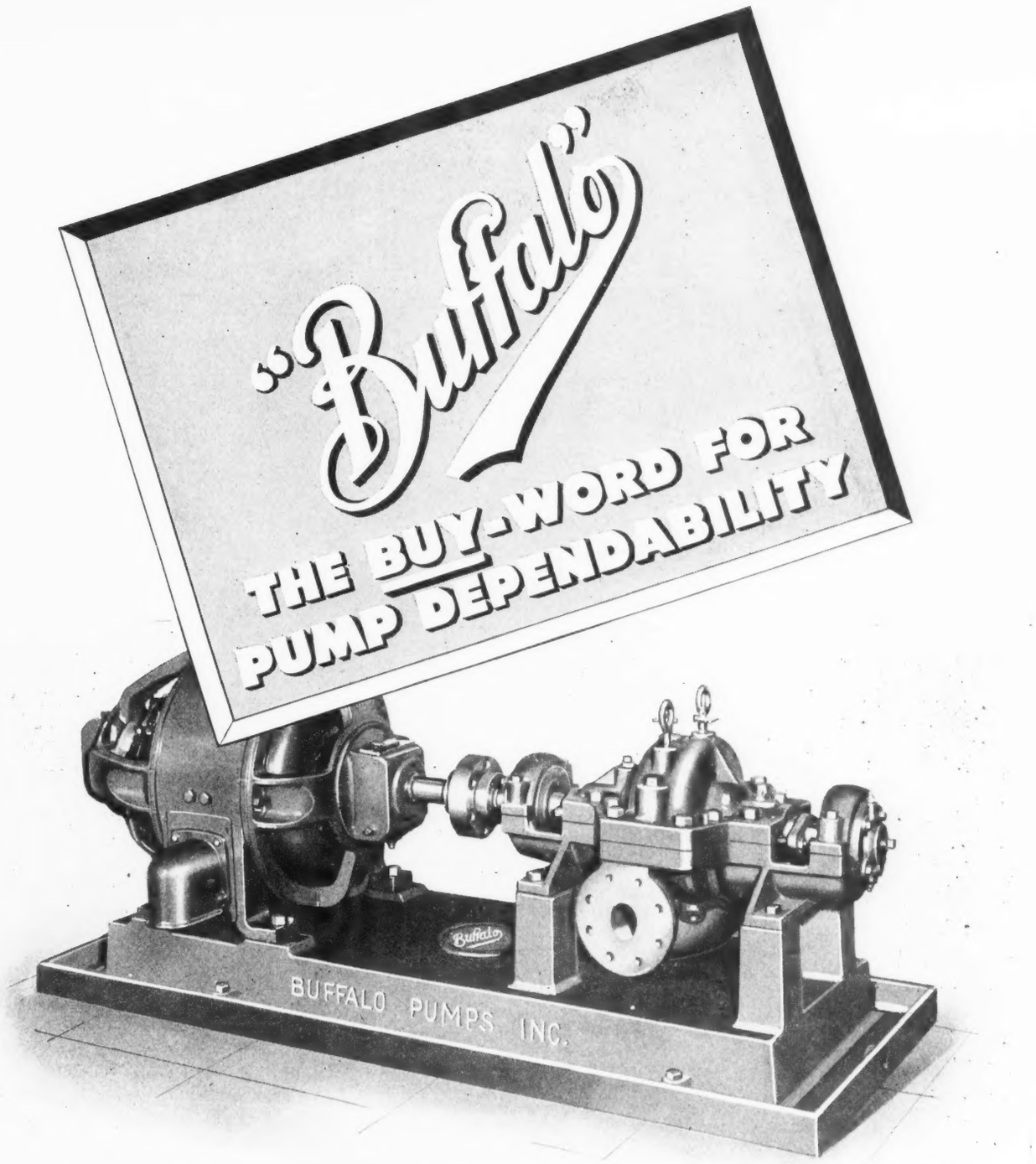
century on October 2, 1941, but the background story of this event was long delayed in transmission to the offices of POWER—came too late even for December publication. In order that this anniversary may not pass unnoticed by our American readers, I shall sum up below certain high points in the life of this great organization, based on material just received:

During its first decade the firm participated in the rapidly growing demand for electrical machinery in all the industrial countries of Europe and increased its staff to 1800. Sensing the necessity for outlets in many countries, Brown, Boveri organized or acquired a controlling interest in affiliated organizations in Germany, France, Norway, Italy, Austria-Hungary, etc.

This trend to decentralized manufacture, with the basic design, research and new developments concentrated in the parent company in Switzerland, continues to this day. Before the outbreak of the present war the Brown, Boveri concern included 37 separate factories in 16 different countries. Moreover, 80% of the total production in the Swiss works is exported mostly to overseas countries. At the present time the home plant of the company employs 7200, while the entire concern, including foreign affiliates, employs 40,000.

Brown, Boveri's impressive list of "first developments" include:

1897	First 3-phase generator for 8,000 volts
1898	First oil circuit breaker
1901	First steam turbine on European Continent
1906	First centrifugal compressor
1909	First single-phase generator (16,000 volts) for railway systems
1911	First commercial metal-tank, mercury-arc rectifier
1917	First commercial supercharging blower for airplanes
1922	First completely automatic rectifier plant for power and light
1925	First refrigerating turbo-compressor
1925	First topping turbine in Europe
1928	Largest (then) turbo-generator set
1930	Largest (then) capacity two-pole turbo-generator
1931	First high-pressure high-efficiency axial flow compressor
1932	First steam generator (Velox) with pressure combustion and forced circulation
1932	First warship with diesel-electric drive
1934	First commercial application of mercury-arc rectifiers for transforming dc into 3-phase



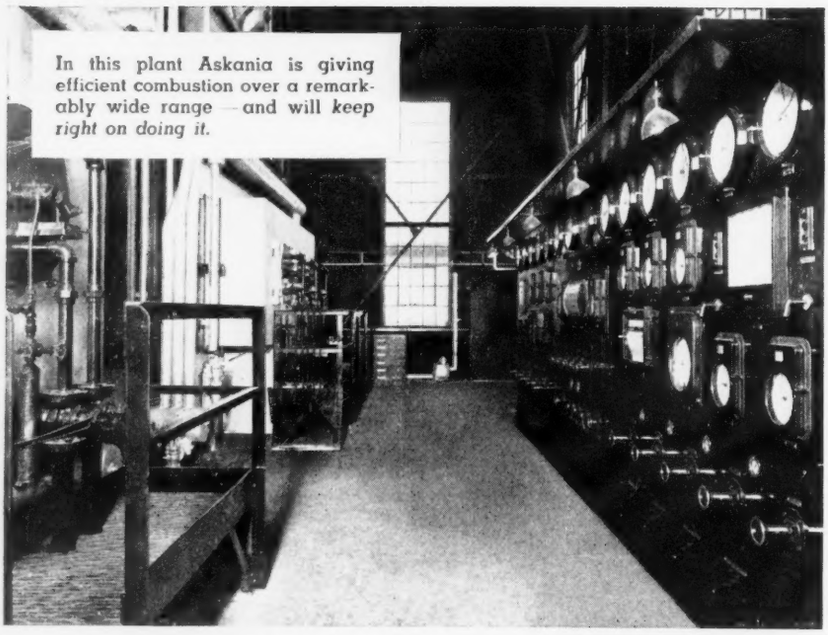
● Just check into the specifications of "Buffalo" Pumps—you'll see at a glance why the Buffalo way of designing and building has chalked up so many records for low-cost, long time service on power plants large and small. Here's a line of pumps you can recommend with confidence for smooth, quiet operation . . . for low power input . . . for money-saving efficiency. There's a Buffalo Pump engineered to fit practically every industrial application. Literature on request.

BUFFALO PUMPS, INC., 488 Broadway, Buffalo, New York

Branch Engineering Offices in Principal Cities

Canada Pumps, Ltd., Kitchener, Ont.

"Buffalo" **PUMPS**



More than ever—

You need this trouble-free control

IN the battle of production, the equipment in the front line should be judged as a soldier is judged—not by the way it starts, but by the way it *keeps going!*

Shut-downs for adjustments mean serious production loss now that boiler capacity is taxed to the limit. Tinkering with equipment that is supposed to be automatic diverts skilled men from jobs that are vital for defense. So today that distinguishing characteristic of Askania Combustion Control—its ability to do its job right day after day and year after year—means even more than ever before.

The recognized ability of Askania Systems to do a better job of controlling combustion—and do it without attention—is basic and inherent in the design of Askania equipment. Simple, precision-built equipment is *always* dependable equipment—and there is no better example of this than Askania Regulators.

The exclusive Askania Jet Pipe Principle not only means greater sensitivity of control; it also means greater *simplicity* of control. Naturally the same number of dollars buy more quality—more precision—in simple equipment than they could buy in complicated equipment. Since oil is used as the operating medium in Askania Regulators, all parts literally "run in oil" and every control-adjustment has the power and certainty of hydraulic operation.

You can put in an Askania System of Combustion Control—and forget it. Its precision-built memory will never forget to hold combustion efficiency at the peak.

ASKANIA REGULATOR COMPANY

Corner 16th and Michigan — Chicago, Illinois

ASKANIA *Combustion* **CONTROL**

1935—First air-cooled mercury-arc rectifier

1937—First gas-turbine-driven compressor set for chemical process with simultaneous power generation (Sun Oil)

1939—First combustion gas turbine. First high-voltage dc transmission through rectifiers

1940—First gas-turbine locomotive

ASHVE Will Meet

The 48th Annual Meeting of the American Society of Heating and Ventilating Engineers at the Bellevue-Stratford Hotel, the 7th International Heating and Ventilating Exposition, at the Commercial Museum, 28th National Convention of the National Warm Air Heating and Air Conditioning Association at Benjamin Franklin Hotel, all in Philadelphia, Pa., will be held the week of January 26.

Registration for ASHVE members will commence Jan 25 at the Bellevue-Stratford and the first business session will open at 9:00 am on Jan 26. The technical sessions will be held each morning at the headquarters hotel and the afternoon sessions will be held in the ball room at the Exposition.

Among the subjects selected by the Meetings Committee for discussion are: studies of panel heating and cooling, operating results of forced hot-water heating systems, friction heads of screwed and welded elbows, jet action of air streams, comfort with summer air conditioning, chimney performance studies, radiator rating tests, sanitary ventilation, heat losses from basement walls and floors. Other reports resulting from the Society's Research Laboratory investigations and those of cooperating institutions will also be given.

Information from exhibitors in the 7th International Heating and Ventilating Exposition indicates that the displays in the Commercial Museum will be most impressive and will be influenced by the industrial mobilization for defense needs. Already, 275 leading

MEETINGS

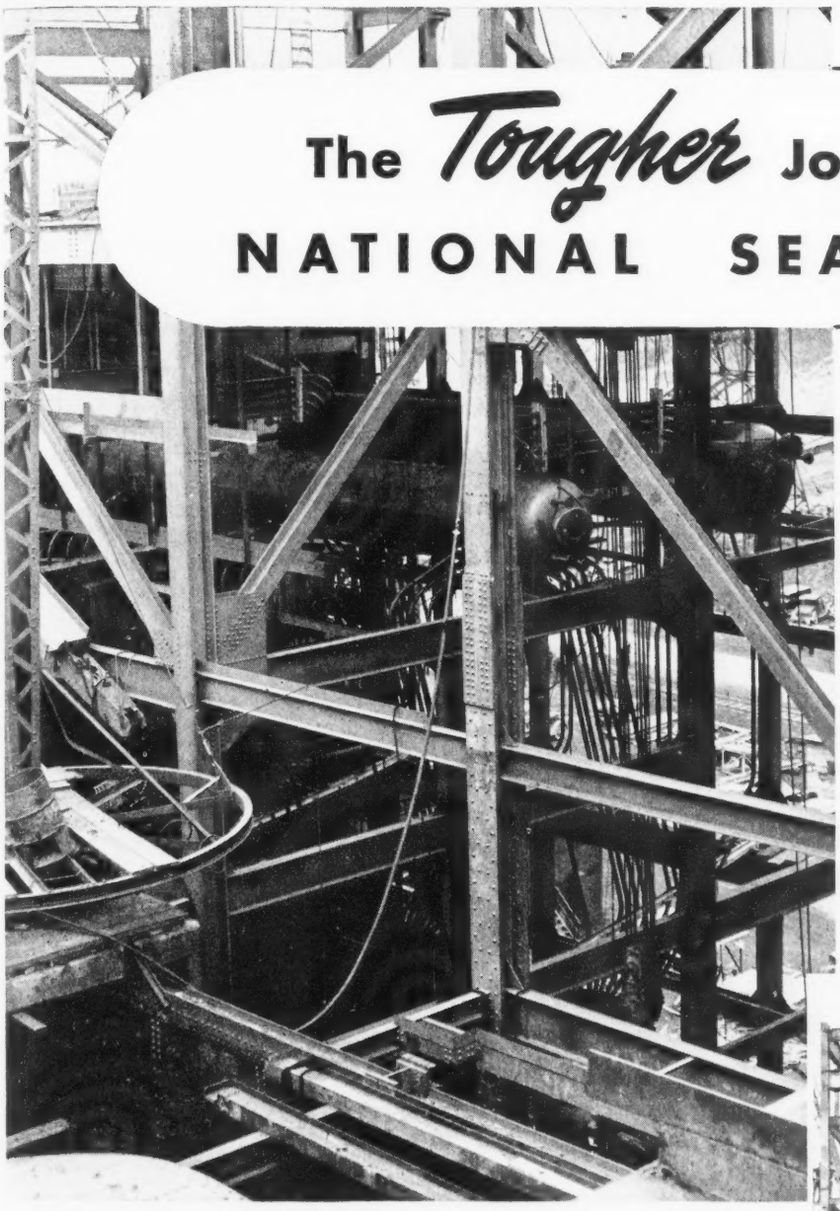
American Association for the Advancement of Science—*Winter Meeting, December 29 to January 3, 1941 and 1942, Hotels Adolphus and Baker, Dallas, Texas.*

American Insitute of Electrical Engineers—*Winter Convention, January 26–30, New York, N. Y. H H Henline, secretary, 39 W 39th St, New York, N. Y.*

International Heating & Ventilating Exposition—*7th Annual Exposition, in conjunction with 48th Annual Meeting, American Society of Heating and Ventilating Engineers, Commercial Museum, Philadelphia, Pa., January 26–30, 1942.*

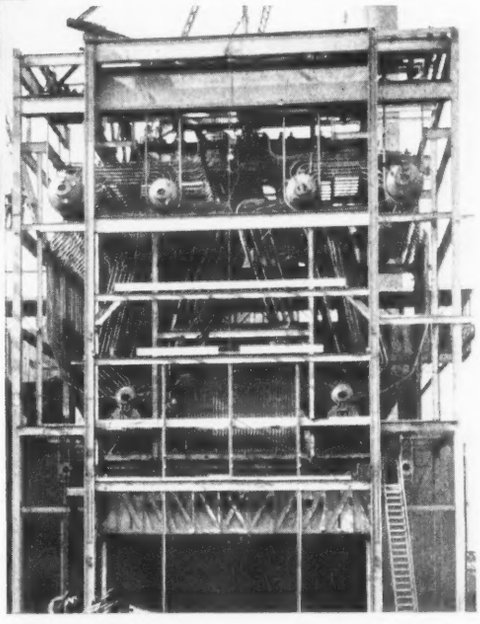
Technical Association of the Pulp and Paper Industries—*Annual Meeting, February 16–19, 1942, Commodore Hotel, New York, N. Y. R G Macdonald, secretary, 122 E 42 St, New York, N. Y.*

The *Tougher* Jobs go to NATIONAL SEAMLESS!



THE "all-out" preference for NATIONAL Seamless Boiler Tubes is based on countless records of performance. Engineers and industrial power experts confidently rely on NATIONAL Seamless Tubes because they have proved time and time again their superiority in the more rigid modern-day requirements of high pressure and high temperature service. They are easily installed because every tube is 100% annealed at the mill before shipment. This assures just the correct balance between strength and ductility.

Whether you're planning on building a new system or making repairs to an old one and the job is unusually "tough," NATIONAL Seamless Tubes will give you longer, safer, more economical service—and save valuable installation time. *Get the facts today!*



Modern "C-E" installations in public utility power stations designed for high capacities

The large installations pictured above represent the trend to the new higher capacity steam generating units. The unit in the top photograph is designed to produce 625,000 pounds of steam per hour at 1475-pound pressure, and 925°F. total steam temperature. The other units shown will produce 1,000,000 pounds of steam per hour at 1425-pound pressure and 925°F. total steam temperature. These are typical NATIONAL Seamless installations.

NATIONAL SEAMLESS MEANS *—pierced from solid billets of finest quality steel. Only sound and flawless steel can be pierced successfully, since any existing defects cannot be covered up in the process. Thorough inspection and tests at every stage in production give you double assurance that each* NATIONAL *Seamless Boiler Tube will display uniform wall strength, uniform physical properties and dimensional accuracy.*

NATIONAL TUBE COMPANY

PITTSBURGH, PA.

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* · United States Steel Export Company, New York

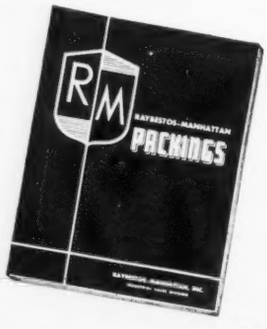
UNITED STATES STEEL

R/M PACKINGS

KEEP WAR-PRODUCTION MOVING SMOOTHLY

Fewer production breakdowns to replace packings! Smoother flow of actual production. Better balanced timing schedules!

That's what happens when R/M packings crack the whip for you. There's nothing tricky about it. Simply the most compact, streamlined *complete* line of packings that will give maximum service with minimum wear for every job. They're born of 40 years' experience in rubber and asbestos, and they're performing in hundreds of plants which now operate above capacity.



Get your own copy of the R/M catalog. Study how few items fit all requirements. Write for a copy on your business letterhead, or see your R/M distributor.

INDUSTRIAL SALES DIVISION
RAYBESTOS-MANHATTAN, INC.
Makers of Packings for Every Industrial Use
BRIDGEPORT, CONN. MANHEIM, PA. NORTH CHARLESTON, S. C. PASSAIC, N. J.

manufacturers have contracted for space in the Exposition and the variety of exhibits will reveal how such equipment is needed for the defense program and will indicate that this essential industry provides for public comfort and health.

The *Committee on Arrangements* for Philadelphia Chapter consists of: M F Blankin, General Chairman; H Berkley Hedges, Vice-Chairman; C B Eastman, Vice-chairman; R D Touton, Secretary; *Honorary Committee*: Homer Addams, G W Barr, J D Cassell, A W Luck and C V Haynes; Committee Chairmen: *Hotels*—Karl Rugart; *Publicity*—J H Hucker; *Entertainment*—W P Culbert; *Ladies*—Mrs M F Blankin; *Banquet*—H H Erickson; *Transportation*—L A Childs; *Inspections*—E H Dafter; *Finance*—A C Caldwell; *Sessions*—R F Hunger; *Reception and Registration*—H H Mather.

The personnel of the Exposition Advisory Committee is: W L Fleisher, Chairman; M F Blankin, J D Cassell, H P Grant, C V Haynes, H Berkley Hedges, J R Hertzler, Lee P Hynes, C S Leopold, F A Leser, Thornton Lewis, F D Mensing, L E Moody, Lee Nusbaum, J Earl Seiter, T H Urdahl, Warren Webster, Jr, C F Ames, Jr, Wharton Clay, Theo, Irving Coe, G C Diehl, W R Hainsworth, W B Henderson, W A Herr, Frank Hoke, R A Locke, A F Nass, A J Nesbitt, H S Sharp, Ernest Szekely, R S Waters, E C Wente, John W West, Jr, and Ray G Whipple.

Hydraulic Institute Awards

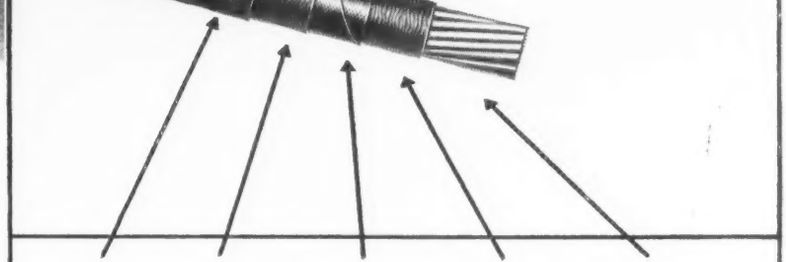
Three prizes for pump papers have been awarded by the Hydraulic Institute, an association of leading pump manufacturers in a competition designed to encourage the writing of essays "of material advantage to the pump industry."

Winner of the first prize of $100, and an engraved silver plaque, was Dr A J Stepanoff, of Ingersoll-Rand Co, for his paper "Design of Mixed Flow Impeller for Centrifugal Pumps." Igor J Karassik of Worthington Pump and Machinery Corp won second prize of $50 with his paper "Speed and Temperature Efficiency Corrections for Centrifugal Boiler-Feed Pumps" and A T Nielsen, also of Worthington, the $25 third prize for "The Centrifugal Pump in the Process Industries."

Presentations were made on Dec. 2, at an Institute dinner at the Waldorf Astoria Hotel, New York City, by Philip W Swain, judge of the contest.

A Foot in time May Save Nine!

Here's What We Mean by Permanent Insulation



A tough asbestos braid finished with compounds resistant to heat, flame, moisture, fumes, grease, oil and solvents.

A dense felted-asbestos wall impregnated with heat, flame and moisture resistant compounds.

Layers of lubricated varnished cambric for high dielectric strength and permanent moisture resistance.

Another felted-asbestos wall to completely seal the varnished cambric from the harmful heat of overloads.

A perfectly centered conductor.

Rockbestos A. V. C. (Underwriters' and N. E. Code Type AVA). Power and Motor Lead Cables have these insulation qualities.

Like everything else, wire is on that endless list of materials hard to get. And that means that any wire failure that makes rewiring necessary is a two-fisted punch on the nose!

Here's a sound suggestion. Go over your lighting, power and control circuits and pick out the spots where wire commonly fails—the hot spots; places where oil, grease, fumes and moisture make trouble; tunnels where wire is run near steam lines; around boilers, furnaces and other heat generators—then give us your minimum footage requirements and preference rating and we'll supply *permanently insulated* Rockbestos just as fast as we can.

A few feet of Rockbestos here and there may save repeated replacements because it is heat-proof, fireproof and resistant to moisture, oil, grease, corrosive fumes and solvents. It won't fail under the toughest going, eliminates production tie-ups, saves time, trouble and money.

118 standard, permanently insulated Rockbestos wires, cables and cords to select from. Anticipate your requirements and send for a catalog.

ROCKBESTOS A.V.C.

The Wire with Permanent Insulation

ROCKBESTOS PRODUCTS CORPORATION, 831 NICOLL STREET, NEW HAVEN, CONN.

"STANDCO" PILLOW BLOCKS

Fig. 1635

Combining clamp block and pillow block requirements in one type, the "Standco" shown above is sturdily built and is offered in a wide range of sizes. Babbitted bearing surfaces are finished beautifully smooth, both faces machined. It can be depended on for long, trouble-free service.

"Standco" Ball and Socket Pillow Block, Ring or Wick Oiling, Plain or Collar End Babbitted Bearings.

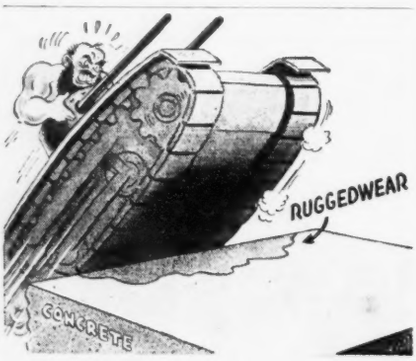
Fig. 32

Write for Bulletin

STANDARD PRESSED STEEL CO.

JENKINTOWN, PENNA.

Boston, Detroit, Indianapolis — Box 577 — Chicago, St. Louis, San Francisco



All-Out Production Demands SMOOTH, TOUGH FLOORS

If you want smooth, efficient concrete floors, even under the most punishing traffic conditions . . . make repairs or resurface an entire area with tough RUGGEDWEAR Resurfacer. No chopping or chipping required. Merely sweep out the spot to be patched—mix the material—trowel it on. Holds solid and tight right up to irregular edge of old concrete. Cellulose-Processed to provide a firmer, tougher, smoother, more rugged wearing surface. Used indoors or out. Dries fast. Low in cost.

Valuable 74-page "HAND BOOK OF BUILDING MAINTENANCE" available to those requesting on business letterhead.

MAKE THIS TEST!

FLEXROCK COMPANY
2377 Manning St., Phila., Penna.

Please send me complete RUGGEDWEAR information . . . details of FREE TRIAL OFFER—no obligation.

Name .....
Company .....
Address .....
City ..... State .....

Marion Davis, for 37 years engineer at Elders Dept Store, Dayton, Ohio, proudly displays a grandson Tommie togged for action against a backdrop symbolizing power for American defense.

W R Hainsworth Elected President of ASRE

Dr William R Hainsworth, of New York, vice-president of Servel, Inc. in charge of engineering, and national authority in the field of refrigeration research, was elected president of the American Society of Refrigerating Engineers at the annual meeting in St Louis.

Dr Hainsworth, who has been engaged in refrigeration research more than twenty years, succeeds L L Lewis, vice-president of the Carrier Corp, Syracuse, N. Y., retiring president.

In 1933, Dr Hainsworth was awarded the Charles A Munroe Award by the American Gas Association for his contributions to the gas industry in the field of scientific research.

Becoming affiliated with Servel in 1929, Dr Hainsworth undertook the direction of extensive research on air cooling and improvements in domestic and commercial refrigeration. In 1935 he became vice-president of the company in charge of engineering.

In 1922, while a research associate at MIT, he pioneered in the development of phototelegraphy. Later, in collaboration with Austin Cooley, now manager of Times Telephoto Equipment, Inc, this research work resulted in the successful transmission of photographs by direct

TIME SAVED ON POWER PLANT MAINTENANCE JOBS *Helps National Defense*

For Example:

CLEANING EVAPORATOR COILS

More power for National Defense! That is the power industry's "order of the day". It means immediate utilization of any material or method that helps keep equipment operating at peak capacity . . . that saves time, effort in handling required maintenance.

For example, by cleaning evaporator coils with Oakite Compound No. 32, you will find it thoroughly, SAFELY removes lime-scale and oxidized deposits, quickly restoring normal heat transfer efficiency. No dismantling of equipment is required, so evaporators go back into service FASTER! Cost is low, too. Write for FREE 24-page manual giving details.

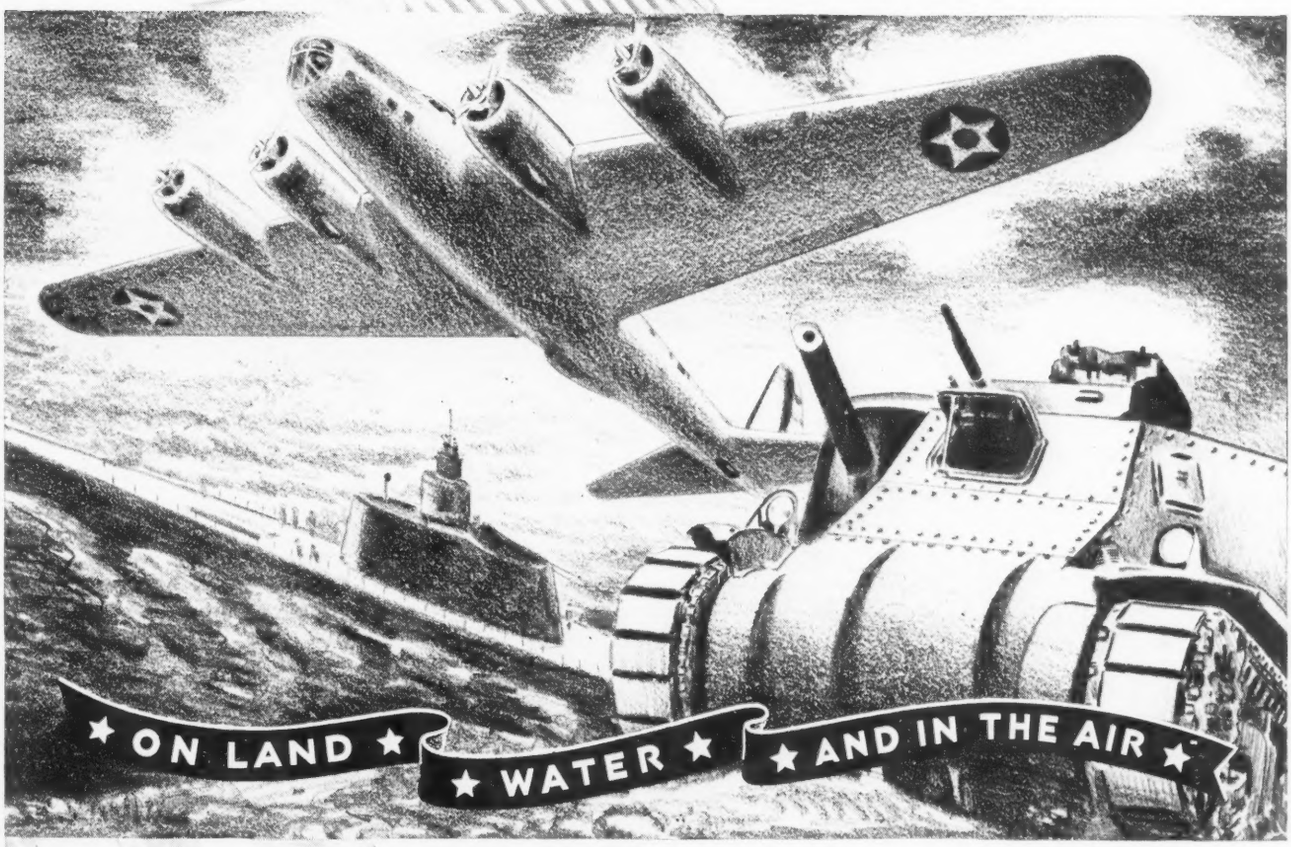
Do All Your MAINTENANCE CLEANING the Faster, Safer Oakite Way

Safely de-scaling and cleaning Diesel water jackets, surface condensers, feedwater heaters, "lube" oil and jacket-water coolers, water-cooled compressors and transformers . . . are other maintenance jobs which Oakite materials can help you do faster, easier. Complete data FREE on request.

OAKITE PRODUCTS, INC.
23 Thames Street, New York, N. Y.
Representatives in All Principal Cities of the United States and Canada.

OAKITE *Certified cleaning*
MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

★ ★ ★ Morse puts Teeth into Defense Equipment ★



IN DEFENSE EQUIPMENT—where the ultimate in power transmission is necessary—you'll find Morse Chain Drives on the job. In defense factories, too, Morse Drives are at work, transmitting all the power from drivers to working machinery efficiently and dependably. "Teeth, Not Tension"—no slippage—no power waste. They have the stamina to roll through overloads, shocks, moisture, dust and fumes without a falter. Investigate what Morse Chains can do for you—consult the Morse man in your territory.

SILENT CHAINS ROLLER CHAINS FLEXIBLE COUPLINGS CLUTCHES

MORSE *positive* DRIVES

MORSE CHAIN COMPANY | ITHACA N. Y. DIVISION BORG-WARNER CORP.

This Book is Yours . . FREE

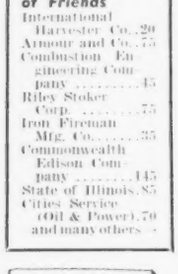
★ Combustion Efficiency as applied to Boiler Plant Operation, Fuels, and Equipment is now a most important factor in Defense work. Fuels cost more than ever before. Boiler loads are heavier. A scarcity of some kinds of fuel is apparent.

The Combustion trained man—the Hays trained man—can do his part, and open up big opportunities for himself that never existed before, by devoting a little of his spare time in training himself to meet present conditions.

How? Through the simple, easy reading, *practical* Hays Home Study Course in Fuel and Combustion Engineering. For 26 years the Hays Institute has specialized exclusively in training in Combustion Efficiency. Hundreds of Hays trained men now hold substantial positions of responsibility. What we have done for them we can do for you, in your spare time. Many companies urge their men to enroll. They know the value of Hays Combustion Training.

Just a Few of Our Hundreds of Friends

International Harvester Co. 20
Armour and Co. 75
Combustion Engineering Company 45
Riley Stoker Corp. 75
Iron Fireman Mfg. Co. 35
Commonwealth Edison Company 145
State of Illinois 85
Cities Service (Oil & Power) 70
and many others



SEND FOR FREE BOOK

The coupon below will bring you, without expense, full particulars regarding the Hays short, practical, easy reading, home study Course in Combustion. Do your part by starting now to train yourself in the uncrowded wide open field of Fuel and Combustion Engineering. Hays trained men are in demand, today more than ever. Send the coupon Now. No obligation of course.

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Please send me your Free Book, "Opportunities for the Combustion Expert". No Obligation.

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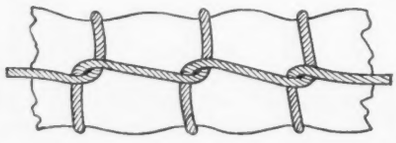
DEPT. 111
430 N. MICHIGAN AVE., CHICAGO, ILL.
Our 26th Continuous Year . . .

wire and its many commercial usages.

Born in Seattle, Wash., on February 22, 1896, Dr. Hainsworth was graduated from the University of Washington in Seattle. He is a member of the executive committee of the Industrial Research Institute.

Old Salts Department

The Marlin hitch shown on page 113 of October POWER will slip unless the ends are secured. As shown originally, below, each loop of the rope is slipped under the lengthwise piece:



The proper hitch will not slip if tied as shown here:

The ends are tucked under the round turn. Accordingly, when the strain is removed, the end does not tend to slip back. Each hitch should form a thumb knot.

Hamilton, Ontario JOHN R DUNBAR

A total of 461 engineering curricula at 129 colleges in the United States have been accredited by the ENGINEERS' COUNCIL FOR PROFESSIONAL DEVELOPMENT, as announced at the 9th Annual Meeting held recently. At this meeting, R E Doherty, president of the Carnegie Institute of Technology was elected chairman.

ASHCROFT GAUGE DIV, MANNING, MAXWELL & MOORE INC, Bridgeport, Conn., is celebrating its 90th birthday this year. Mr Ashcroft, founder of the company, built the first Bourdon-Tube pressure gage in the United States. Ashcroft saw his gage on exhibition at the first International Industrial Exposition in London in 1851 and obtained exclusive right to manufacture it in the United States.

OHIO INJECTOR CO, Wadsworth, Ohio has issued digest entitled "Government Regulations; Priorities and Valves." Information concerning this can be obtained from the company.

A COMPLETE LINE OF

GAUGES

FOR

INDICATING STEAM, AIR, WATER, OR OTHER PRESSURES VACUUM, AMMONIA, HYDRAULIC COMBINATION IN BRASS, IRON OR STEEL CASE

Precision-built by master craftsmen, LONERGAN gauges operate on some of the toughest jobs in the world . . . users say, with unvarying accuracy and spectacular endurance. If that is the kind of gauge performance you're seeking—here it is, undeniably proved!

J. E. LONERGAN COMPANY
Race and Second Sts.
Philadelphia, Pa.

Lonergan
GAUGES
VALVES · SPECIALTIES

300 Specialties for Power Plants - Since 1872

For Plants that Need MORE POWER in a Hurry!

INDUSTRIAL PLANTS working on defense contracts, or otherwise able to obtain priority ratings, can get a quick, efficient solution for many of their power and steam shortage problems by writing or wiring American Coal Burner Co. *immediately*.

QUICK DELIVERY — **Standardized construction features permit quick delivery of AMERICAN FYR-FEEDER spreader stokers to meet requirements of virtually any size boiler plant, old or new.**

HIGH OVERLOAD CAPACITY — **FYR-FEEDER installations invariably provide ample excess capacity to enable plants to handle new peak loads.**

MORE EFFICIENT USE OF METAL — **There is no "dead weight" in a FYR-FEEDER stoker! Units are simple, compact, and require a minimum of special fittings, materials, etc.**

CONSERVE FUEL. **FYR-FEEDER stokers burn coal, wet or dry, with high efficiency. Hundreds of AMERICAN FYR-FEEDERS units now in service are producing a high return on their investment. *For details, write* AMERICAN COAL BURNER CO., 203-18 E. Erie St., Chicago, Ill.**

AMERICAN FYR-FEEDER SPREADER STOKERS

THE CONQUERING KILOWATTS

by Lowell Thomas

ONE of the absolutely prime requisites for national defense is *power*—power to put industry in high gear—power to do the almost inconceivable task that lies ahead. For power is the parent of every gun, every tank, every plane, every ship. It is truly America's first line of defense.

How *much* power can America produce?

It took a little digging on my part to discover that, right now, our power capacity exceeds that of Italy, Germany and Japan *combined*. Today we have fifty-five million kilowatts. Within another year American capacity will be at least sixty million kilowatts . . . sixty-four million by 1944.

Simple Terms

Those are big figures, but what do they mean, brought down to simple visual terms? Well, one kilowatt is the same as one and one-third horsepower. That means a single kilowatt has the working strength—the actual physical energy—of 14 strong men. On an efficient treadmill they would be able to lift 500 pounds one mile straight up in the air in an hour . . .

Now multiply those 14 husky men (equal to one kilowatt) by the more than 100 billion kilowatt hours that were sold by power companies last year and you would have power equivalent to more than *seven hundred million men*, working forty hours a week, fifty weeks a year!

Just look what that means! Seven hundred million of these mechanical workmen are enough to provide the equivalent of more than twenty workmen for every family in America . . . And you and the munitions factories can *get* those mechanical men to work at the snap of a switch! You have here, it seems to me, a beautiful example in strictly human, flesh-and-blood terms of what American power engineers have been able to do to reduce back-breaking toil—to make life more worth while for all of us—and to speed national defense production in our present emergency.

Power Enough Exists

The facts support our power company executives when they say we will have enough power to meet any immediately foreseeable demand.

"Okay," says the Man in the Street, "we've got enough kilowatts—millions more than Hitler has. But how do they compare to the requirements of defense plants, and can they keep our houses and stores lighted and run our non-defense factories at the same time?"

That was what I asked Colonel H. S. Bennion, Vice-President and Managing Director of the Edison Electric Institute, which is, among innumerable other activities, the central information bureau of the Power Industry.

"Speaking in general," said the Colonel, "there are plenty of kilowatts for every purpose at the present time, despite the heavy defense loads we have taken on.

"You see, the electric industry maintains in normal times a reserve generating capacity averaging about 35% over normal requirements. This is a reservoir of power that can be tapped to meet extraordinary needs.

"And there is still another reserve that can be utilized," Colonel Bennion continued. "The 'peak load' is sustained for only about four hours a day. The other twenty hours we operate at only 45% of total capacity. Merely by re-adjusting working hours in a certain percentage of factories, we could thus add another ten per cent to the juice available without switching in a reserve generator or using any of our reserve fuel."

"Have most of the additions in our power capacity been in Federal plants like T.V.A., Bonneville and Grand Coulee?" I queried.

"No. Those are big plants and they're doing a swell job," the Colonel replied, "but it's our electric companies, operated under efficient American business management, who are responsible for carrying out the major part of our power preparedness program. All the Federal Government power plants together supply only a little more than 7% of the nation's power—municipal plants perhaps another 5%. The great majority of power is generated by privately owned and financed companies. Perhaps I should say publicly owned and financed, because their stockholders are numbered in millions."

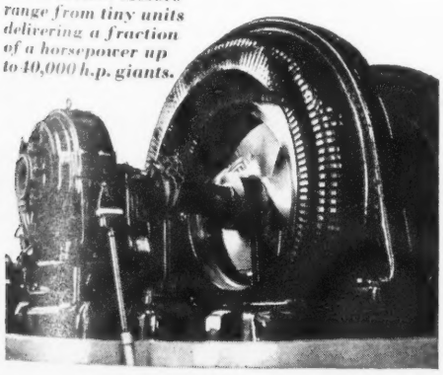
That is the broad, general statistical background of Power in Defense. Adequate power now and expanding capacity for future needs.

Doers—not Talkers

Power men are all a good deal like the quiet, efficient mechanisms they tend and operate.

(Continued on next page)

VERSATILE! *Motors range from tiny units delivering a fraction of a horsepower up to 40,000 h.p. giants.*



NOTE TO READERS:

The article reprinted here appears, as Johns-Manville paid advertising, in the January 24th issue of the *Saturday Evening Post*. It is one of a series by well-known writers on the defense achievements of the major industries of the country.

Because of our long and close association with these industries, Johns-Manville knows, at first hand, the job which Industry is doing in arming our country. But we are convinced that too few people realize the magnitude of that job and, like other manufacturers, we believe it is vitally important that this story be told to the widest possible audience.

It is our sincere hope that this series in the *Saturday Evening Post* will be helpful in informing the public of the indispensable job American Industry is doing in this time of our greatest National Emergency.

Johns-Manville

This is the seventh of a series of advertisements sponsored and paid for by Johns-Manville. For more than 80 years this company has been serving America's basic industries.

How indispensable these industries are to the American Way in time of peace is generally recognized. This series is to help inform the public of the indispensable job these industries are doing in this time of great National Emergency.

Johns-Manville is proud of the contributions its products are making in helping the Electric Power Industry, as well as other industries, produce defense material quickly and at the lowest possible cost.

JOHNS-MANVILLE

THE CONQUERING KILOWATTS

(Continued from preceding page)

They function with little sound and no fury. And while they have plenty of imagination in doing their work, they don't allow themselves much in talking about it.

They'll tell you casually about spanning fifty or a hundred miles of wilderness with a 25,000-kilowatt line to a new training camp or an armament plant. But they won't speak of the eighteen-hour days of executives who don't get home to dinner once a week, of engineers whose cots are set up beside their drafting boards, of purchasing and material men who plead and wheedle to get supplies, and of surveyors, right-of-way men, diggers and bulldozers and foresters and linemen who clear the path for the power and erect the high voltage lines along which the kilowatts travel.

Keep 'em Marching!

"Our job is to maintain supply," said H. F. Smiddy, operating head of Electric Bond and Share Services, who was interviewed together with President F. W. Bird of Montana Power Company and Kinsey Robinson, President of Washington Waterpower.

"In other words," said Mr. Bird, "it's our job to keep the kilowatts marching and bring up the reserves as commanded." "And it is noteworthy," said Mr. Smiddy, "that it is the integration of corporate structures that has made possible the interconnection of once-scattered individual operating companies so that power can be spread or concentrated where and when it's required for defense."

"For example," said Kinsey Robinson, "an aluminum plant, which burns up more power than a city the size of Spokane, might be placed, for strategic reasons, in a district where the local power supply was inadequate. But through interconnected lines we could shunt enough power from the surplus of other companies in the system to wipe out the shortage."

"And if there isn't a line to that local plant," added Mr. Bird, "we string one, and the kilowatts get there. I don't know of an important instance in the whole electric network of the country where a power need for a defense plant hasn't been met on time or ahead of it."

Expansion—300%

Whether I talked with holding company heads or operating company executives, I got the same quietly confident story. I found reason for their confidence in the history of the power industry, which, in the characteristic American way, has expanded 300% in twenty years while the population has increased by but 25%.

Throughout the industry I sensed that a spirit of genuine, cheerful and competent co-operation with the government's all-out defense effort was universal.

I learned, from President E. L. Shea of the North American Company and a representative of American Gas and Electric, that electric expansion programs were begun as early as 1939 in anticipation of growing needs for national defense.

Foresightedly, the industry was mobilizing its kilowatts before the action started. What this means for production, and how promptly the kilowatts can be mustered, is illustrated by just one of the examples cited by President H. P. Liversidge of Philadelphia Electric.

"After nearly twenty years of idleness," said Mr. Liversidge, "Cramp's Philadelphia Shipyard prepared to re-open. The Manager phoned me, 'Can we have power in thirty days?' 'In thirty hours,' I told him, 'if you need it.'

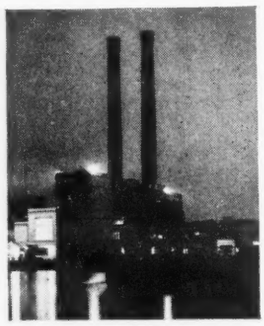
"Perhaps it looked like a large gesture, but I was merely stating a fact. We've been able to take the job of powering a 50% increase in defense production in our stride. Bendix, Baldwin Locomotive Company (making heavy tanks), the Navy Yard, scores of factories making every variety of war machines and supplies—they've all had the power when they wanted it, they'll continue to have it for the duration."

—And that situation in the Philadelphia area isn't at all unique . . .

A hundred miles out of St. Louis the Army built Fort Leonard Wood, a camp housing 30,000 soldiers, eventually to hold 80,000. Power lines were run from Union Electric's system to the camp—far outside its territory—and the kilowatts marched in and kept the situation well in hand. Other Union Electric Company kilowatts in ample number were dispatched over other new lines to a T.N.T. plant at Weldon Springs, Missouri, and another munitions factory at Burlington, Iowa.

Down in Louisiana a camp for 40,000 men was laid out. The Army asked the Louisiana Power and Light Company for power in ninety days. Delivering that power meant 600 poles, 400,000 pounds of copper, thousands of insulators, hundreds of transformers, and two complete substations. It meant slashing the right of way through brush, swamps and forests. But the kilowatts marched in—in 75 days!

These operating electric companies in an interconnected system cover the country with a vast network. And from Houston to Boston, Jacksonville to Chicago, and San Diego to Seattle, the power needed in any particular spot has been delivered. Power, you see, is as vital to a nation's military production as is blood in your veins. A country can have men and materials (muscle and bone), but it can't produce planes and tanks without the lifeblood of power. That's why, so often, you read about bombing attacks on power plants in Germany, Occupied France and Italy . . . That's why, when they had to retreat from the Dnieper River, the Russians blew up their beloved Dnieperstroy Dam. Power means production. Production—enough of it in time—means invincible military strength.



EFFICIENCY. ***Research has achieved 300% increase in power output from steam-generated electric plants with no increase in fuel consumption!***

In America all our defense demand, up to now, has been superimposed upon the normal, non-defense requirements of light and power. Utility men say that defense production can be greatly increased and still be handled without cutting the householder's lights or power for luxury items. But they foresee—and business indices already indicate—that defense production is bound to cut into non-defense work, which will lessen the civilian and commercial demand for current. This means that the strain on power resources will be in that degree lessened. "Either way," said a power engineer, "the conquering kilowatts will march on."

For this quiet certainty that power will be adequate, the equipment companies are also responsible. They have accomplished literal miracles in supplying the tools of power production. And along with this job for the utilities, the electric powering of battleships, cruisers, airplane carriers for the Navy and the electrification of merchant ships has been increased and speeded to a degree where only "miracle" is the word.

If anybody wants to call me over-optimistic and over-enthusiastic about America's power plant, that's their good American right of free speech. But I believe that the hardest boiled cynic, or even the dourest defeatist, confronted with the facts as I have found them, would have to concede that the intelligence, energy and daring of private industry are doing a dynamic job of power production.

Built the American Way

Here is an industry that was really ready for national defense. Electric power is now driving 86% of the factory wheels of America. And almost nine-tenths of this vast power mechanism was built and operated by private enterprise, seeking an opportunity for profit, in the matchless American Way. In that search were developed new uses and new markets for power, new comforts and standards of living for Americans, at ever higher efficiency and with ever lower cost. Backed by the savings of millions of small investors, private industry has marshalled the peacetime kilowatt forces into an army more than adequate to America's production needs in a wartime emergency.

If the outcome of our battle for Democracy depends on power (and many believe it does) the kilowatts are already becoming Conquering Kilowatts in the service of Uncle Sam. And, as far as I can see into the future, they will *continue* their forward march until that final day when the Conquering Kilowatts of Democracy will light the blazing splendor of our Victory Parade.

This is the seventh of a series of advertisements sponsored and paid for by Johns-Manville and designed to tell the American people how indispensable our basic industries are for National Defense.

— JOHNS-MANVILLE —

What's the best way to clean tubes?

Somebody inquires now and then about the best way to operate a tube cleaner — whether the "back and forth" or the "straight ahead" system is to be preferred.

In this case, the easiest system is also the best — the "straight ahead" method is the way to do it. Just ease the tube cleaner ahead into the tube, thoroughly cleaning as you go. In this way the cutters work on a shoulder of scale rather than upon its inner surface. There is minimum contact between cutters and tube wall. Patches of scale are not likely to be left. The experienced operator can tell by the feel and sound of the cleaner when the tube wall is freed of scale and can govern his feeding of the cleaner accordingly.

For a fast, smooth and thorough job of tube cleaning, you must have good equipment. This means Elliott-Lagonda tube cleaners. They are made in types and sizes for cleaning any tube in boilers ashore or afloat, in condensers, tube stills and other heat exchange apparatus. **There are more than 40 years of "knowing how" back of the co-operation you get from Elliott engineers. Write us.**

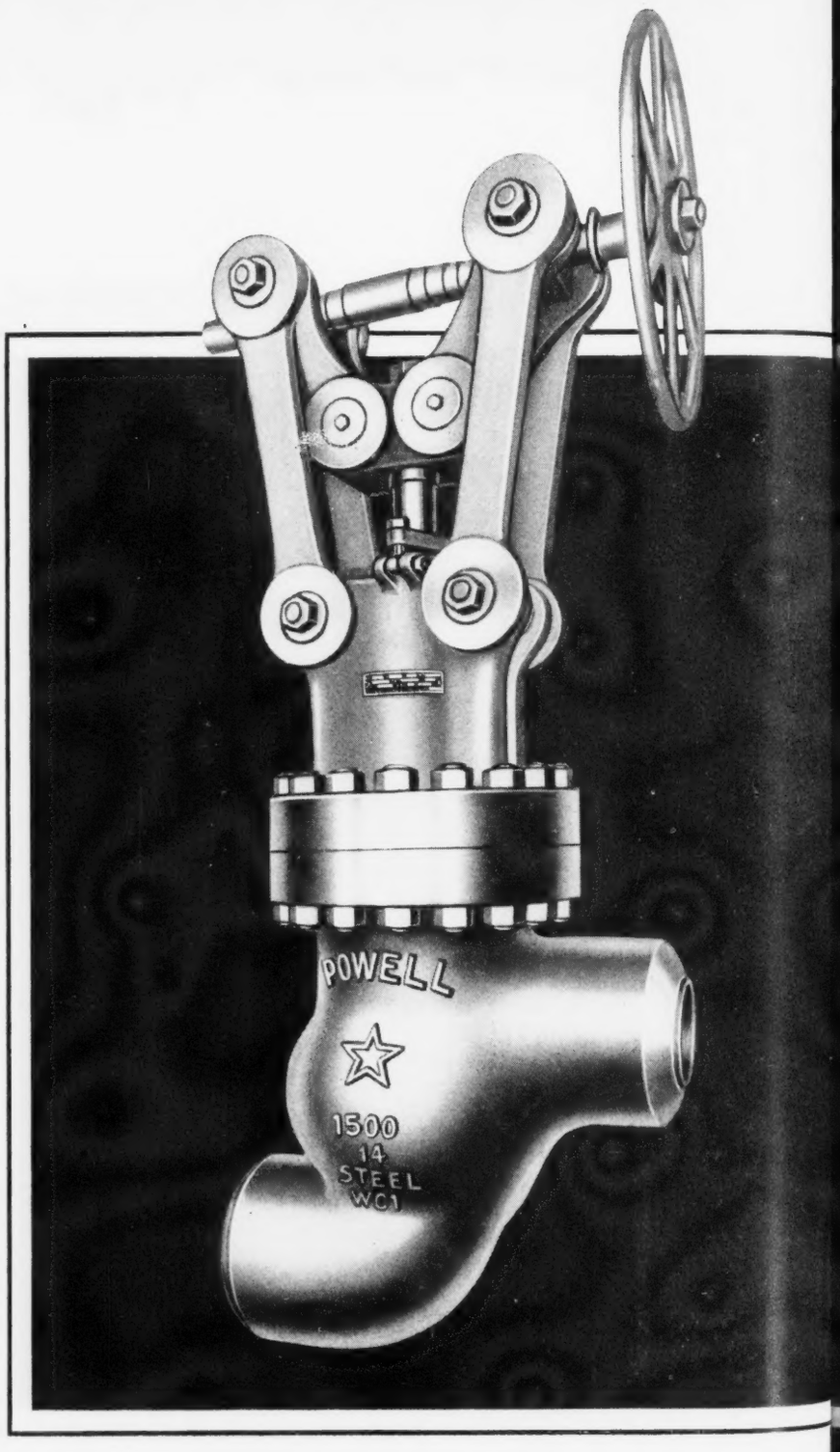
Come to TUBE CLEANING HEADQUARTERS for informative data, equipment and accessories

ELLIOTT COMPANY
LAGONDA-LIBERTY *Tube Cleaner Dept.*
SPRINGFIELD, OHIO
DISTRICT OFFICES IN PRINCIPAL CITIES

Y-179

ELLIOTT-LAGONDA TUBE CLEANERS

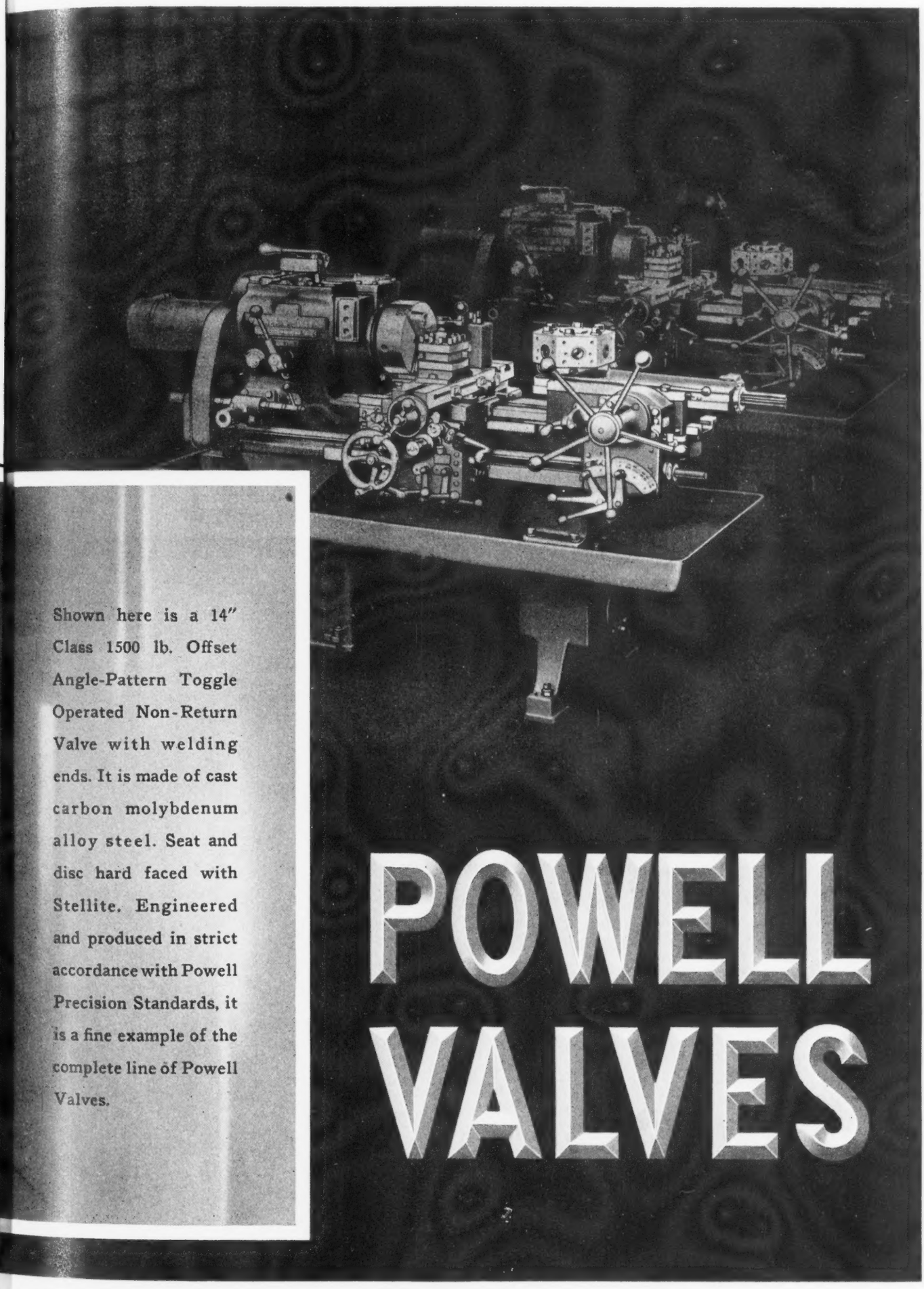
Service



Advanced engineering conducted by highly trained specialists using the most modern laboratory equipment. Quantity production on a vast array of up-to-the-minute machines. The readiness and ability of the Powell technicians to lend their experience and skill to the solution of each and every valve problem which is imposed by the constant changes in the present industrial picture.

These are the things that habitual users of Powell Valves become accustomed to. The result of them, as expressed in terms of valves, is sturdiness, efficiency and economy. This, to the people at the Powell plant, is the meaning of service.

The Wm. Powell Company
Cincinnati, Ohio

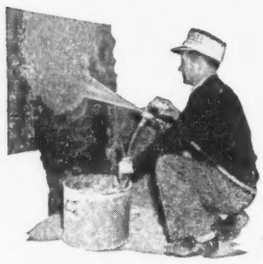


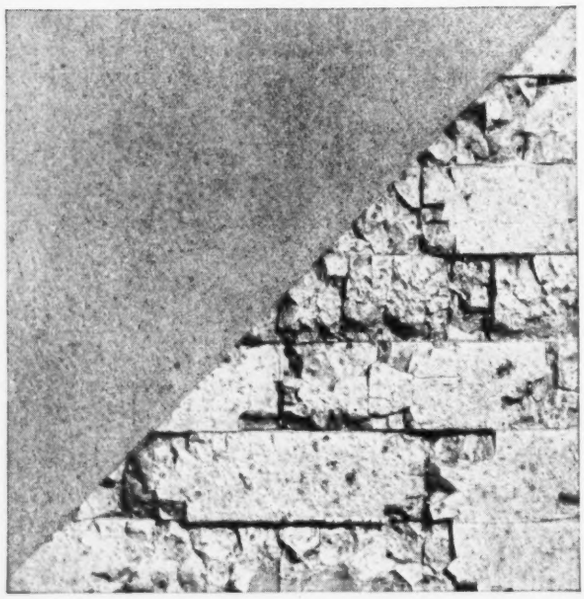
Shown here is a 14" Class 1500 lb. Offset Angle-Pattern Toggle Operated Non-Return Valve with welding ends. It is made of cast carbon molybdenum alloy steel. Seat and disc hard faced with Stellite. Engineered and produced in strict accordance with Powell Precision Standards, it is a fine example of the complete line of Powell Valves.

POWELL VALVES

RE-condition your furnace walls —

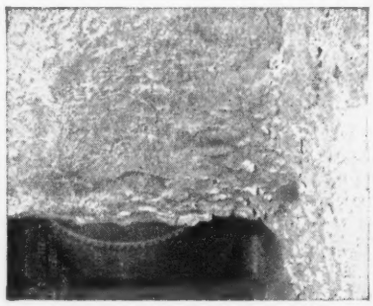
Build up spalled or worn away linings with GREENCOTE



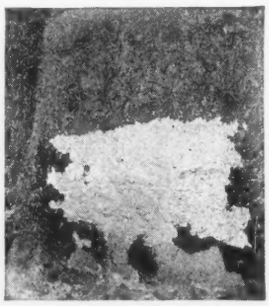


APPLICATIONS OF GREENCOTE over spalled brick make it possible to build the lining back to its original thickness.

Spalled or burned sections of furnace walls can be made as serviceable as the rest of the lining by applying GREENCOTE. This coating material reconditions the lining by building up eroded or burned refractory surfaces to their original thickness. Old walls can be kept in constant repair. Repeated applications of GREENCOTE over the entire refractory lining can greatly lengthen the life of the original setting. Frequent and costly relining of furnaces often made necessary by wear on small sections can be eliminated. Its use is simple and inexpensive.

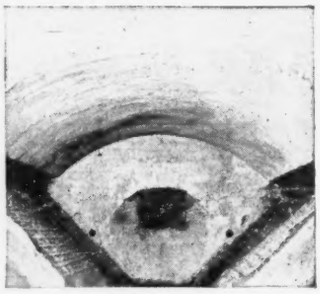


GREENCOTE SAVED this arch. Before the application of this refractory maintenance coating, this arch in a 200 h. p. boiler was so badly spalled replacement seemed necessary.



LOCALIZED "HOT SPOTS" where erosion occurs can be reconditioned with GREENCOTE and costly repairing of the furnace eliminated.

BURNER RINGS can be easily maintained by the use of GREENCOTE.



PERIODIC COATINGS of GREENCOTE prolong the life of refractory arches and cut repair bills.

What is GREENCOTE? GREENCOTE is a refractory — just like the lining of the furnace, but possessing properties that make it possible to apply it as a coating to restore burned or worn away surfaces. Is as refractory as high heat duty fire brick and will adhere just as well to hot or cold, new or old refractory surfaces. Its high refractoriness makes it resistant to slag, erosion and spalling. GREENCOTE can be easily applied by troweling or spraying. Comes in 100-pound bags.

★ CONSERVE — DEFENSE COMES FIRST

To meet the needs of industry and national defense, the already increased production of our plant is being speeded. But we are working against an abnormal backlog of orders for fire brick. Delivery promises are often long. Naturally, defense comes first —so help yourself and your country by making every effort to get longer life from the refractory linings you have. The A. P. Green Co. manufactures many products, which are in stock for immediate shipment, to meet such needs. Our Refractory Engineers are always available to work with you and help you devise means of getting longer life and greater service from what you already have.

Quick Delivery — Local Stocks & Service

Warehouse stocks are located near you for prompt delivery. Look in the classified section of your local telephone directory for the name of your nearest A. P. Green representative.

A. P. Green
FIRE BRICK COMPANY
MEXICO, MISSOURI

REFRACTORY PRODUCTS FOR EVERY INDUSTRIAL USE

MANHATTAN RUBBER helps the flow of *Steel* into a thousand shapes—for Defense ★ ★ ★

The sparks and the glow and the lurid liquids that flow from furnace and ladle are the climax of grandeur in the saga of steel.

But this molten spectacle is but one scene in the solid drama of metallurgy where rubber plays a varied role.

MANHATTAN makes hundreds of products which help shape billet and bloom to the needs of Man as well as of Mars.

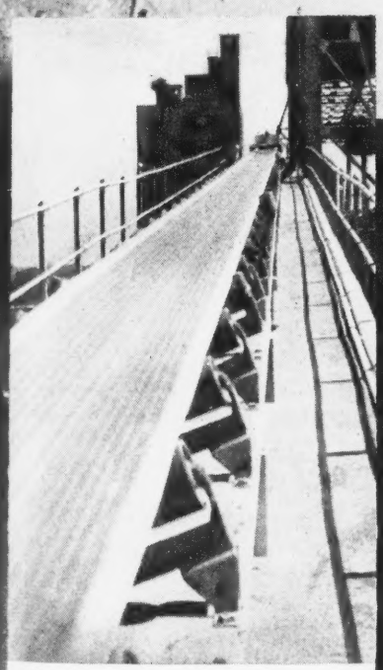
Ore and coal, coke and limestone travel from mine and quarry on rubber conveyor belts; air and water and steam are borne through rubber hose; parts are welded, sand-blasted, pickled and plated with the aid of rubber. These and an astonishing list of other products—like abrasive wheels for snagging and cutting off, and asbestos brake lining for cranes and hoists—are part of what MANHATTAN makes for the Steel Industry under the banner of Defense.

★ ★

A few MANHATTAN Products used by the Steel Industry

- Conveyor Belts, Mildew-proof
- Rubber Belting
- V-Belts
- Hose for Acid, Air, Chemicals, Sand-Blasting, Steam, Water and Welding
- Fire Hose
- Furnace Door Hose
- Rubber-Lined Pickling and Plating Tanks
- Rubber Covered Rolls
- Abrasive Wheels
- Brake Lining, Clutch Facings
- Asbestos Cable Covering
- Asbestos Products
- Molded Goods and Packing
- Rubber Pipe

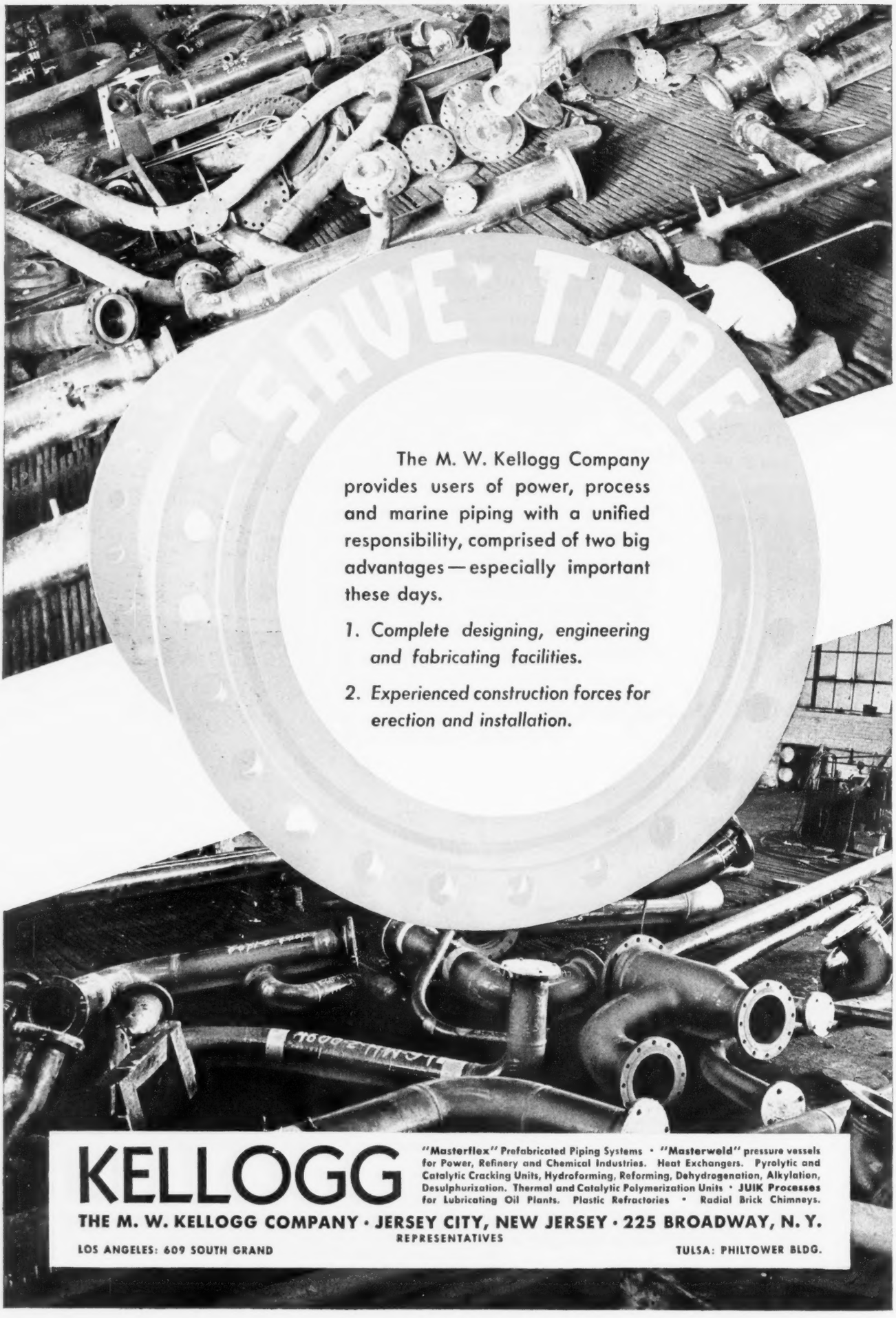
★



● A typical Manhattan conveyor belt installation in the steel and allied industries.

KEEP AHEAD WITH MANHATTAN

THE MANHATTAN RUBBER MFG. DIVISION
of RAYBESTOS-MANHATTAN, INC.
GENERAL OFFICES and FACTORIES—PASSAIC, NEW JERSEY



The M. W. Kellogg Company provides users of power, process and marine piping with a unified responsibility, comprised of two big advantages — especially important these days.

1. *Complete designing, engineering and fabricating facilities.*
2. *Experienced construction forces for erection and installation.*

KELLOGG

"Masterflex" Prefabricated Piping Systems • **"Masterweld"** pressure vessels for Power, Refinery and Chemical Industries. Heat Exchangers. Pyrolytic and Catalytic Cracking Units, Hydroforming, Reforming, Dehydrogenation, Alkylation, Desulphurization. Thermal and Catalytic Polymerization Units • **JUIK Processes** for Lubricating Oil Plants. Plastic Refractories • Radial Brick Chimneys.

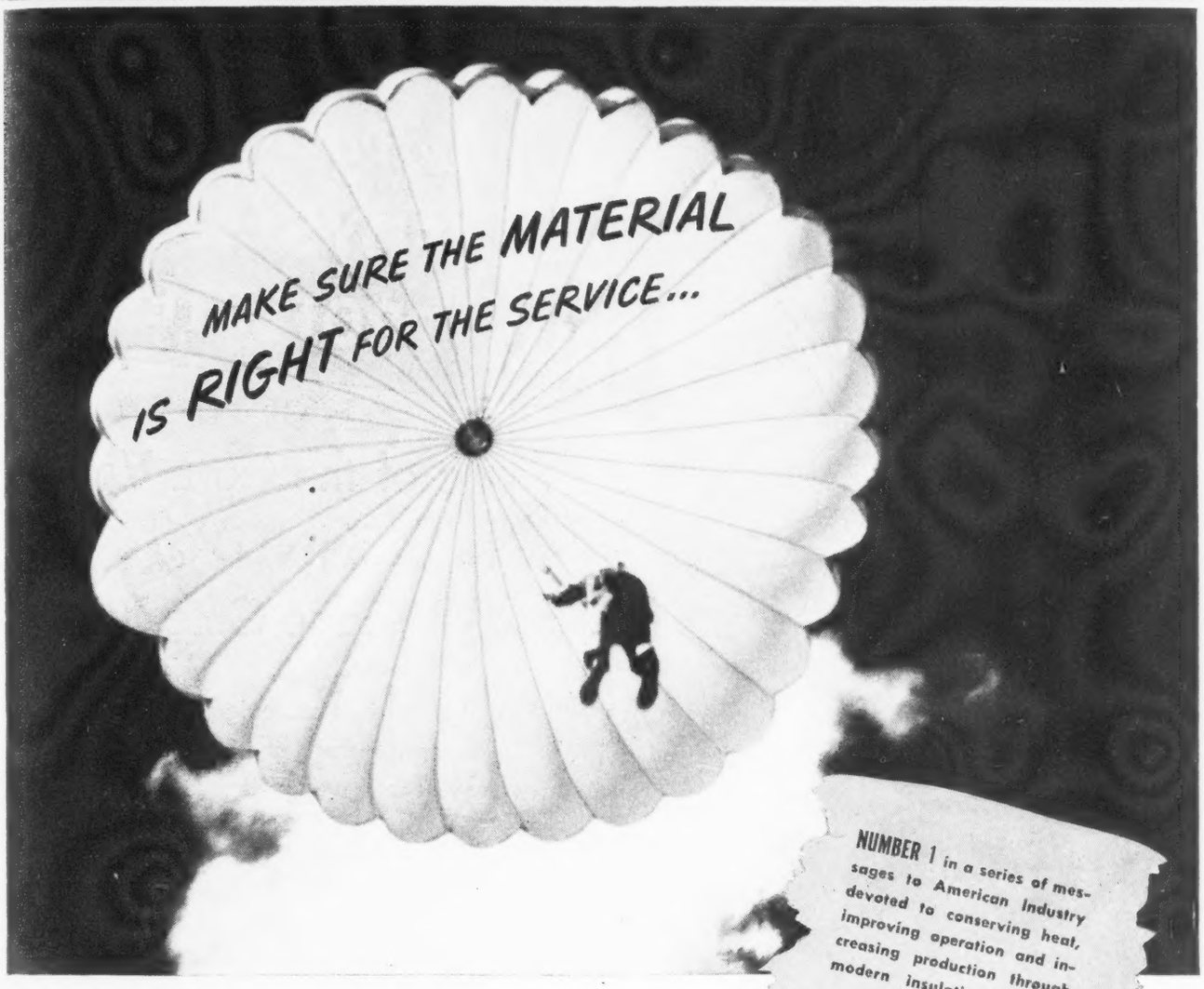
THE M. W. KELLOGG COMPANY • JERSEY CITY, NEW JERSEY • 225 BROADWAY, N. Y.

REPRESENTATIVES

LOS ANGELES: 609 SOUTH GRAND

TULSA: PHILTOWER BLDG.

GETTING THE *MOST* FROM YOUR THERMAL INSULATIONS...



NUMBER 1 in a series of messages to American industry devoted to conserving heat, improving operation and increasing production through modern insulation practice.

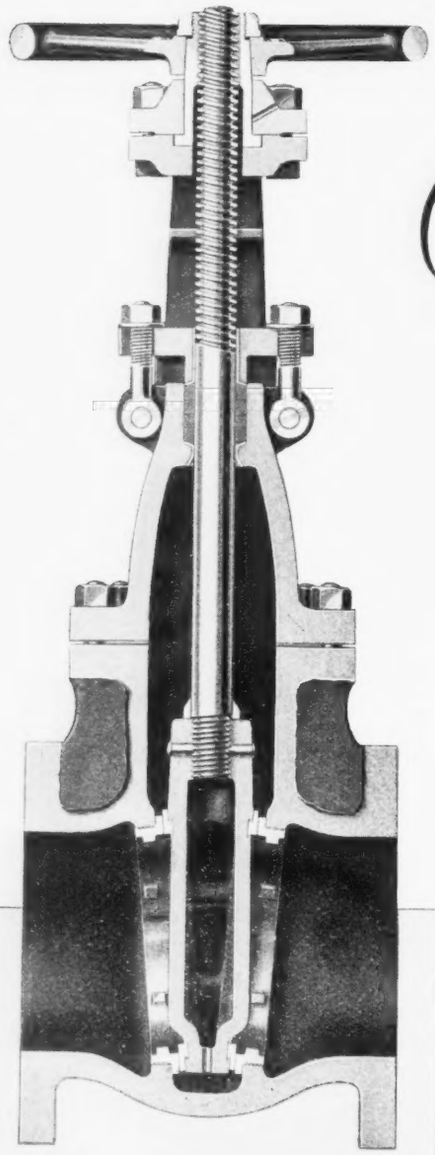
There can be no compromise in specifying the fabric for a parachute—for obvious reasons. And thermal insulations, which are industries' protection against heat loss, should be as carefully chosen for the temperatures and service conditions involved. The failure of an improperly used insulation is seldom dramatic, but always costly.

In times like these, when increases in steam pressures and process temperatures are the rule, it is sound practice to check your present insulating materials—and your insulation requirements—and to specify the proper Ehret insulation for your particular service needs.

★ **EHRET'S 85% MAGNESIA** and many other Ehret heat insulating materials are fully treated, both as to selection and application, in the new 176 page Heat Insulation Handbook. It will be furnished, without obligation, to those interested in getting the most from their thermal insulations. Write today for your copy of Handbook A 201.

EHRET MAGNESIA MANUFACTURING CO.
VALLEY FORGE, PENNA.

...THERE IS AN *EHRET* DISTRIBUTOR OR CONTRACTOR IN EVERY INDUSTRIAL AREA



Protected against corrosion . . . . .
by bronze bushings at all stem contact surfaces, and rust-proofed stuffing box bolts

Protected against side play . . . . .
by yoke nut rotating in machined yoke recess, and deep machined disc guides

Protected against leakage . . . . .
by extra-wide accurately fitting seat and seat ring faces made of specially hard bronze

Protected against operating strain . . . .
by large-diameter high-strength stem with heavy acme threads

Protected against distortion . . . . .
by strong oval body and flanges, with reinforcing ribs

Where Valves may be vulnerable KENNEDYS *are* FULLY PROTECTED!

. . . . one of the Extra Values in KENNEDY Iron-body Wedge Gate Valves

WHEREVER a valve is subjected to destructive influences, there you will find special protective provisions in every Kennedy type.

Some of these provisions in Kennedy Standard Iron-body Wedge Gate Valves, for example, are listed in the panel at the left. In addition, the bodies, bonnets and yokes are made of exceptionally dense, fine-grained metal which is 50% stronger than ordinary cast iron, and all bronze parts are made of tough, hard red metal.

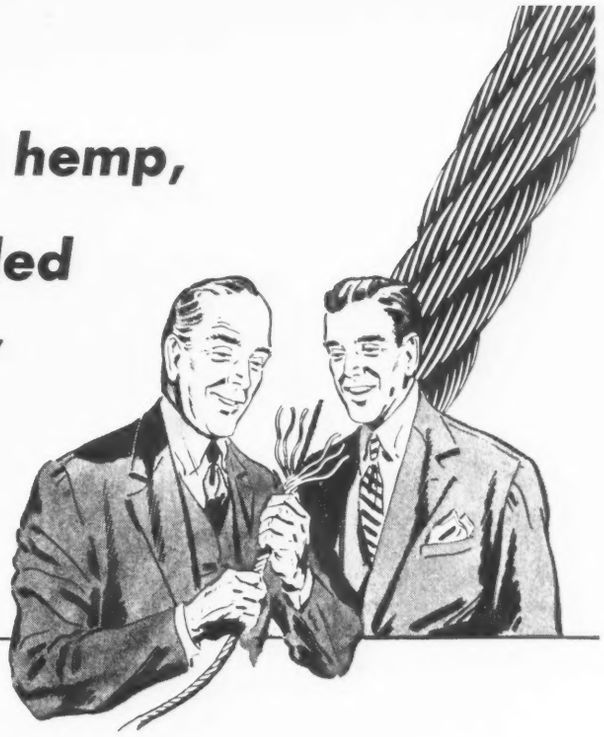
Exceptional protection against destructive influences is but one of the extra values built into every Kennedy Valve at no extra cost to you. Be sure to specify Kennedy Wedge on your next iron-body gate valve order — you will be glad you did so.

Write for bulletin describing these valves in detail

The Kennedy Valve Mfg. Co., Elmira, N. Y.

KENNEDY
Valves and Pipe Fittings

"You put in steel, and hemp, and something called Experience . . ."



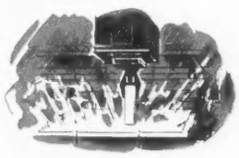
It's something only time and tasks can bring

"Make all the tests you want of wire rope samples. Pull them apart, into steel and hemp, and still you'll never find the quality that's paramount. The makers' experience . . . *knowing how.*

Our experience here at Roebling has two dimensions. You can count it on the map or on the calendar. You can see it working from the ingot to the finished reel.

When Doctor Beebe's Bathysphere sank down into the ocean's depths, a full half mile, his lifeline back to sunlight was a single length of Roebling "Blue Center" Wire Rope. When the builders of Mud Mountain Dam, Enumclaw, Washington, built a 35,000 pound tent that would cover half a city block, to protect their fill, Roebling Wire Rope was chosen to support its immensity, to hold against wind and rain.

Equipping the world's largest power shovel . . . building the Golden Gate and George Washington bridges . . . lifting lives from the world's deepest mine . . . Roebling is both the teacher and the pupil, whenever we tackle such a job. All across the country, on its lakes and oceans, Roebling's learning every day ways to make "Blue Center" better than before. Experience . . .



As Roebling field men learn from rope at work, new generations here at Trenton are learning secrets from the old. Father is teaching son how to tell when an ingot is ready to leave the soaking pit, to be kneaded into Roebling billets. Roebling engineers are learning more and more of wire rope's jobs, and how to meet them to a 'T'.

Roebling research is uncovering brand new facts that will make this trade mark mean even more to-morrow . . ."

JR ROEBLING

Experience of men in the Roebling mills, of Roebling men in the field . . . Roebling process control, and engineering, and research . . . there's many a hidden ingredient in "Blue Center" Wire Rope. Reasons why it lives so long, and never fails to deliver its full measure of service.

JOHN A. ROEBLING'S SONS COMPANY
TRENTON, NEW JERSEY
Branches in Principal Cities

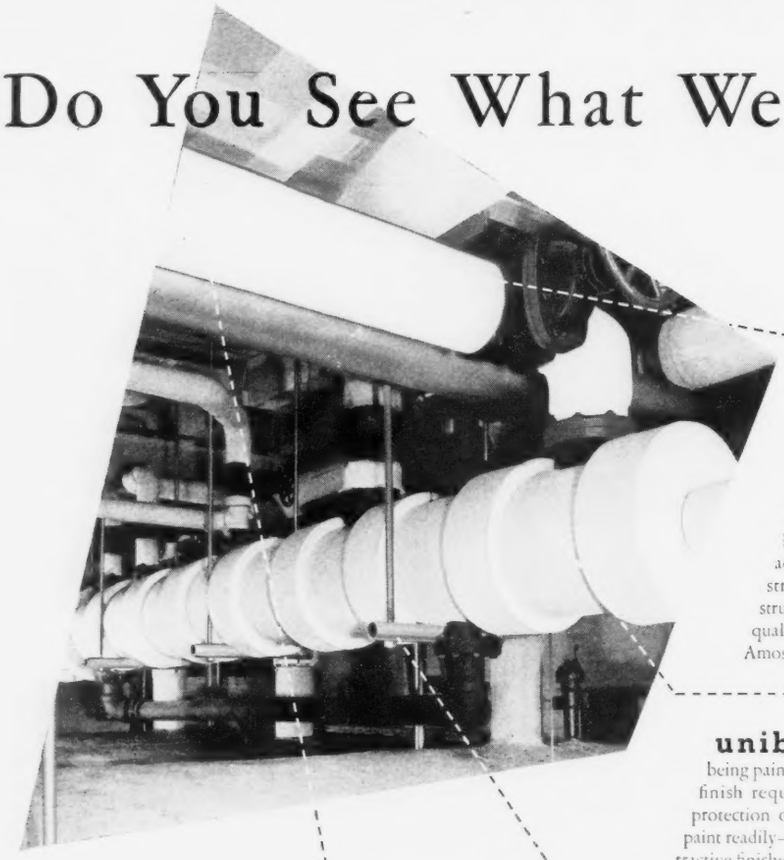
THAT'S THE ONLY WAY TO MAKE

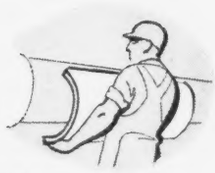
ROEBLING

"Blue Center"

STEEL WIRE ROPE
PREFORMED OR NON-PREFORMED

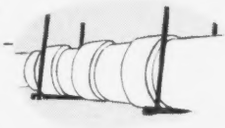
Do You See What We See?





unibestos . . .
pipe insulation being applied to the flanges as well as the pipe in this steam header. Here are illustrated the advantages of sectional construction, light weight and structural strength—inherent qualities of Unibestos, the Amosite asbestos insulation.

unibestos . . .
being painted. Hard, smooth finish requires no further protection or finish. Takes paint readily—presents an attractive finished appearance.



unibestos . . .
greater structural strength. Large pipes can be supported without cutting out insulation at bearing points. No metal-to-metal contact when Unibestos is on the job.

unibestos . . .
being reapplied. Because Unibestos can take it (thanks to Amosite)—it will not shake-down, calcinate or shatter even under most severe conditions—can be used over and over again.

unibestos . . .
is providing insulating efficiency and economies for plants throughout the country. For greater structural strength, higher thermal efficiency, easier application - they're using Unibestos—the Amosite asbestos insulation!

UNION ASBESTOS AND RUBBER CO.
1821 S. 54th ST., CICERO, ILL.

UNARCO

unibestos: CONSERVES THE VITAMINS OF INDUSTRY . . . THE **B.T.U.**

1842 1942

100th anniversary

1842

Walworth manufactured
the *first* American made
valve 100 years ago

1942

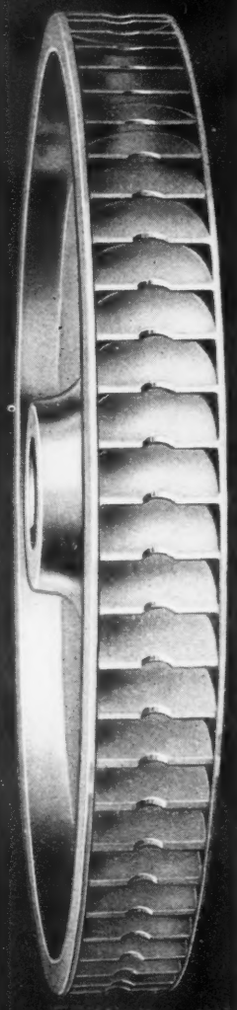
WALWORTH

VALVES
FITTINGS
and TOOLS
Backed by
100 Years' Service

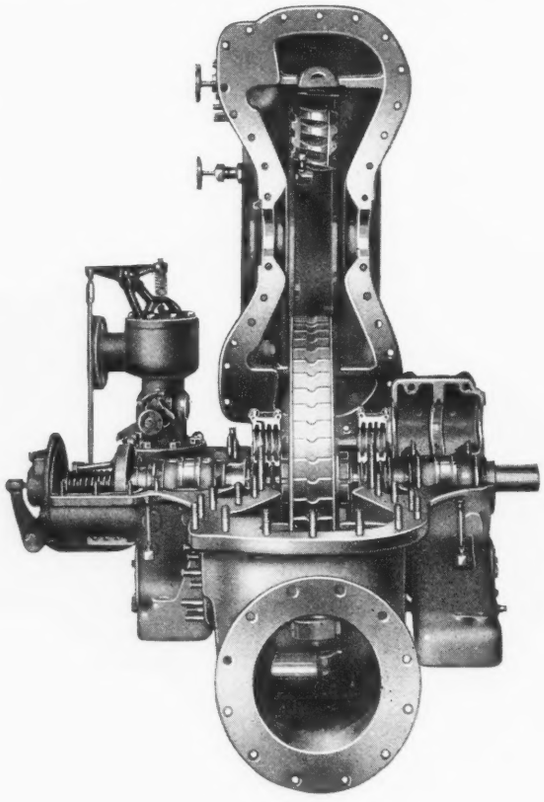
WALWORTH COMPANY
60 EAST 42nd STREET, NEW YORK

DISTRIBUTORS IN PRINCIPAL
CENTERS THROUGHOUT THE WORLD

TERRY



SOLID WHEEL TURBINES are DOUBLE-RIM PROTECTED



In Terry Wheel Turbines the blades are protected by rims at the sides of the wheel, which would take without damage any rubbing that might occur if the clearance became reduced.

With this construction it is impossible for the blades to foul and frequent inspections of the thrust bearing are not required to obtain safe and dependable operation.

This and many other features of Terry wheel turbine design are fully described in our bulletin S-116. A request on your business letterhead will bring a copy.

Above:
Typical Terry Wheel Turbine with cover raised. Unit is rated 400 HP at 3500 RPM with steam conditions of 650 lbs. — 825 TT — 2 lbs.

T-1140

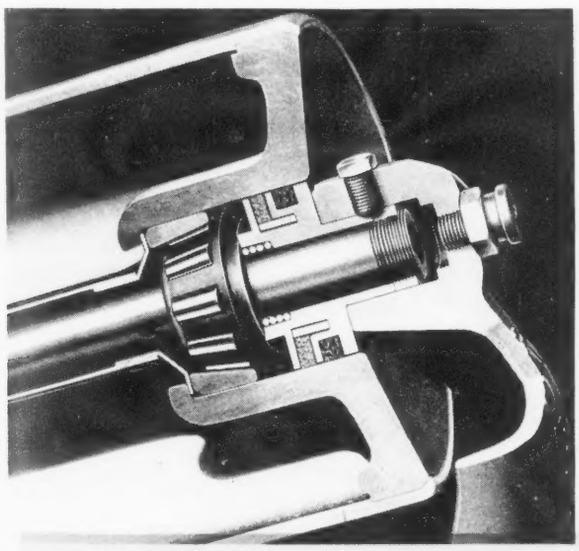
THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

LOOK AHEAD!

After the war -- reduced industrial power demands. Keep power costs down with advanced equipment containing Timken Bearings throughout.

Timken Bearing Equipped belt conveyors handle coal quickly and economically. Above is a Robins Belt Conveyor Idler.

Sectional view of Robins Belt Conveyor Idler Roll showing application of Timken Bearings. Effective closures keep lubricant in—dirt and wet out.



Timken Tapered Roller Bearings play an important part in power generation. They are helping all kinds of power plant equipment keep ahead of war requirements.

Power costs are never so important as they are when power demands drop. That is why every power plant operator should be planning now for future possibilities.

Weed out stokers, conveyors, hoists, pumps, compressors, pulverizers or any other equipment that is costing too much to operate and maintain. Replace wasteful machines with new ones in which every point of friction and hard service is protected by Timken Bearings. Then watch power costs slump.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

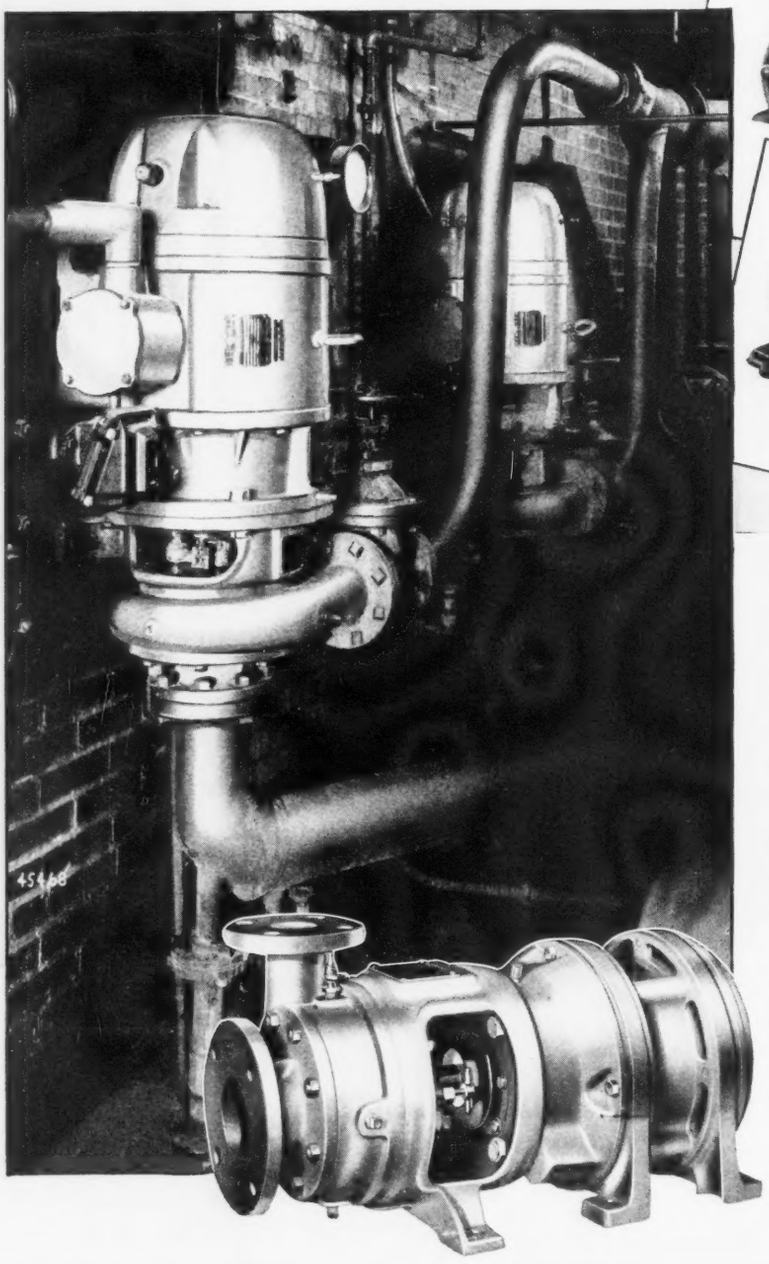
Manufacturers of Timken Tapered Roller Bearings for automobiles, motor trucks, railroad cars and locomotives and all kinds of industrial machinery; Timken Alloy Steels and Carbon and Alloy Seamless Tubing; and Timken Rock Bits.

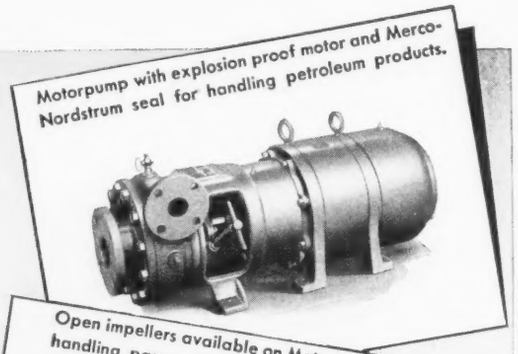
TIMKEN

TRADE-MARK REG. U. S. PAT. OFF.

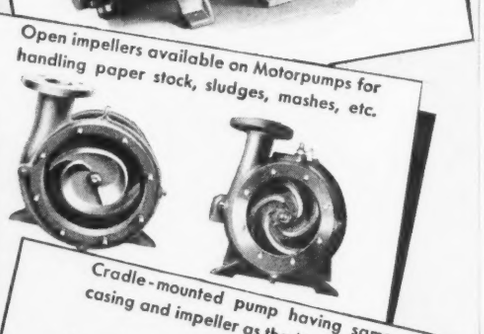
TAPERED ROLLER BEARINGS

A PUMP TO FIT YOUR NEEDS

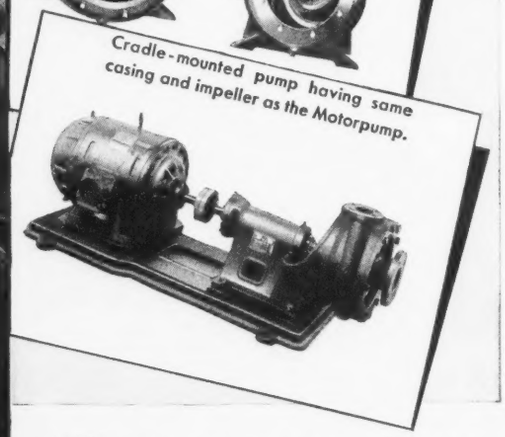




Motorpump with explosion proof motor and Merco-Nordstrum seal for handling petroleum products.



Open impellers available on Motorpumps for handling paper stock, sludges, mashes, etc.



Cradle-mounted pump having same casing and impeller as the Motorpump.

● The Motorpump is a versatile unit—it is available with motors of practically any type for all usual current conditions—highly efficient closed impellers are furnished for handling water, oil and other clear liquids. Open impellers are available for handling sludges, paper stock, mashes, etc.—smothering type stuffing box glands can be furnished for hot or volatile liquids.

In short a Motorpump exactly suited to your needs is available. Capacities from 5 to 1500 gals. per min; heads to 500 feet. Shipment from stock.

The Cameron

MOTORPUMP

An Ingersoll-Rand Product

Atlanta, Birmingham, Boston, Buffalo, Butte, Chicago, Cincinnati, Cleveland, Dallas, Denver, Detroit, Duluth, El Paso, Hartford, Houston, Kansas City, Knoxville, Los Angeles, Newark, New Orleans, New York, Philadelphia, Picher, Pittsburgh, Pottsville, Salt Lake City, San Francisco, Scranton, Seattle, St. Louis, St. Paul, Tulsa, Washington

Ingersoll-Rand

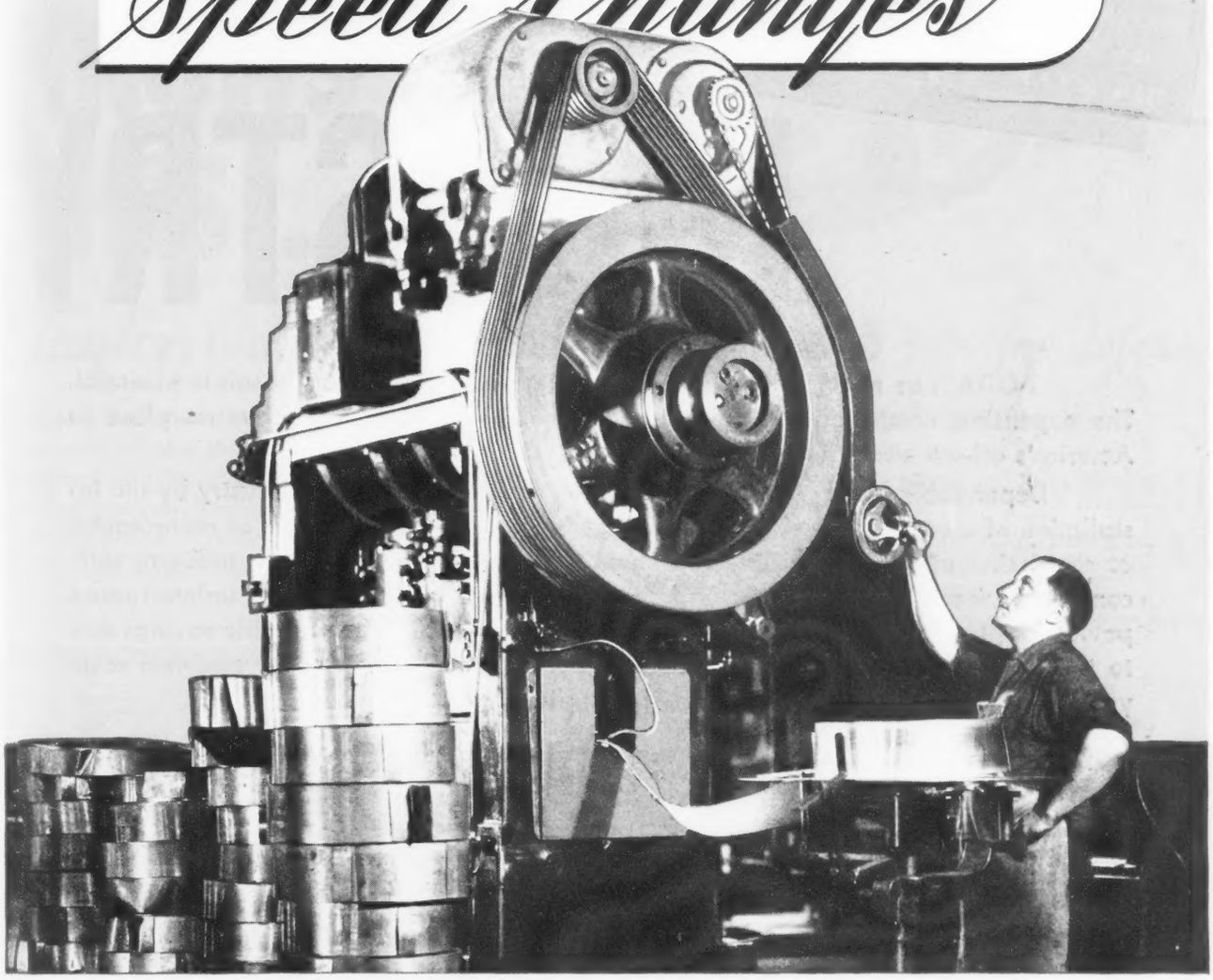
CAMERON PUMP DIVISION

11 BROADWAY, NEW YORK CITY 9-61

Branches or Distributors in other Principal cities the world over.

Montreal • Mexico • Havana • Rio de Janeiro • Caracas • Buenos Aires • Lima • London • Paris • Madrid • Lisbon • Melbourne • Calcutta • Johannesburg

No Time Out for Speed Changes



● Ability to change speeds quickly and accurately is contributing importantly to National Defense in thousands of manufacturing plants where machines are equipped with REEVES Variable Speed Control.

"Down time" is just as costly to the defense program when it occurs as the natural consequence of inadequate speed control, as it is when strikes or sabotage interrupt the flow of essential production.

We have no time to spare *now* for changing belts and gears, when speeds can be regulated by the simple operation of turning the REEVES handwheel, *without stopping the machine.*

If you have a machine in essential production which is "not doing its best" on account of inflexible speed operation, write, wire or phone us. We build so many different sizes of three basic speed control units that there will be no difficulty in selecting the one you need. Our entire organization is "on its toes" to assist in the big job American industry has to do.

REEVES PULLEY COMPANY
Department F **Columbus, Indiana**

Reeves
SPEED CONTROL

Superior DIESELS

HEAVY DUTY MODELS: 50 to 960 H. P. 250 to 700 R. P. M.

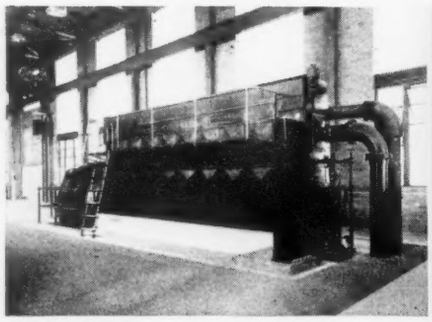
111

HIGH SPEED MODELS: 15 to 230 H. P. 600 to 1800 R. P. M.

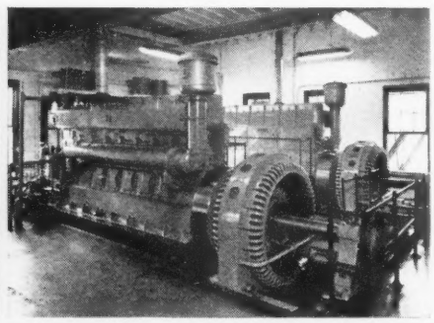
POWER FOR INDUSTRY

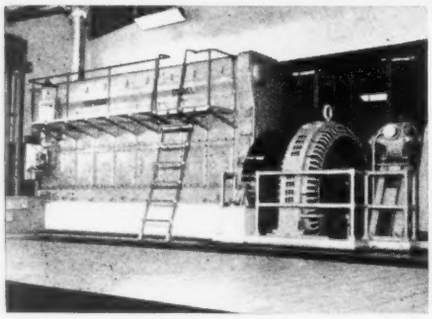
TODAY, as never before, reliable economical power is an absolute essential. The expensive, erratic output of an ancient, obsolete power plant has no place in America's all-out effort for Democracy.

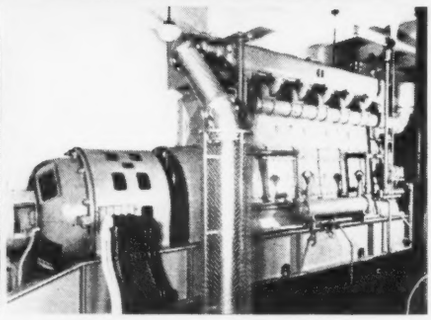
Dependable, continuous, low-cost power is available to any industry by the installation of a compact, sturdy Superior Diesel—in either a new plant or replacement or expansion of present facilities. In hundreds of installations, these modern, self-contained Diesels have conclusively demonstrated their ability to furnish uninterrupted power for practically every branch of American industry, with remarkable savings due to the lowered production costs . . . A survey by a competent power engineer costs you nothing but the asking. Why not investigate?

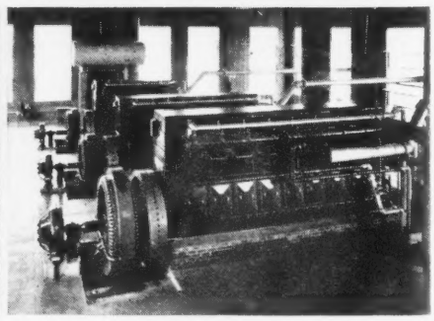


Typical plants in diversified industries where Superior Diesels are effecting substantial savings in power costs.









THE NATIONAL SUPPLY COMPANY . . . SUPERIOR ENGINE DIVISION

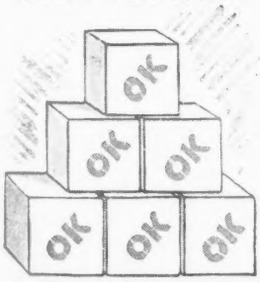
SALES OFFICES: Springfield, Ohio; Philadelphia, Penna.; New York, N. Y.; Los Angeles, Cal.; Jacksonville, Fla.; Houston, Texas; St. Louis, Mo.; Fort Worth, Texas; Tulsa, Okla.; Boston, Mass. FACTORIES: Springfield, Ohio; Philadelphia, Penna.

UNCLE SAM KNOWS THIS...

Taylor Instruments are doing **NOT 1 BUT 5** *jobs for defense*

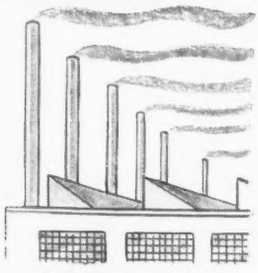
▶ Everything that Taylor makes is made to measure. Every instrument that Taylor makes for Industry is designed to indicate *precisely*, or record *precisely*, or control *precisely*. Taylor-made precision protects Industry's power to produce today. These are the jobs —*not 1 but 5 jobs*—that Taylor Instruments are doing for defense:

TAYLOR INSTRUMENTS HELP MAKE BETTER PRODUCTS



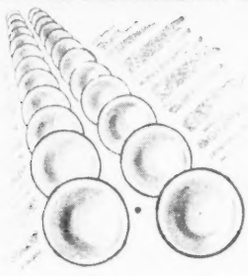
Constant top-grade perfection comes from using Taylor Instruments, because they permit complicated processing operations to be carried on automatically.

TAYLOR INSTRUMENTS HELP SPEED UP PRODUCTION



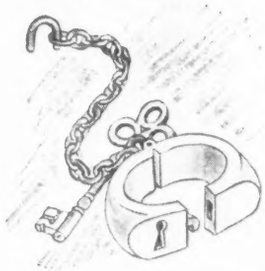
With Taylor Instruments on guard over industrial operations, insuring automatic precision, products can be turned out faster. Mishaps due to human errors get far less chance to gum up the works.

TAYLOR INSTRUMENTS HELP INSURE UNIFORMITY



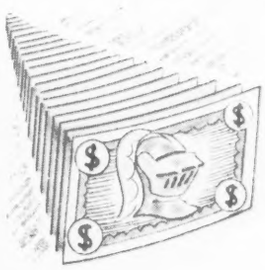
Exact duplication of operations, guaranteeing exact duplication of mass-made products, can be indefinitely carried on if Taylor Instruments are used to record and control those operations with the automatic exactness that human skill can't match.

TAYLOR INSTRUMENTS HELP FREE MANPOWER



Skilled employees in a Taylor-equipped plant do much less "sentry duty" merely watching over operations. They are freed for other more essential work. Taylor Instruments are automatic industrial sentries.

TAYLOR INSTRUMENTS HELP MAKE DEFENSE DOLLARS GO FARTHER.



Uncle Sam is likely to get more of the best for his money from plants using Taylor Instruments. Why? Because, by using Taylor Instruments, these producers often can cut their production, maintenance, and labor costs noticeably and can sell to the Government at lower prices without cutting profits!

Taylor Instruments should be doing these five—not one but five—jobs for you, too. We want you to be getting 100% satisfaction from your present Taylor Instruments, and we're here to see that you do. Perhaps we can suggest ways to improve your instrument performance. We've had plenty of experience in this industrial instrument business. How can we help you most? Taylor Instrument Companies, Rochester, N. Y. Plant also in Toronto, Canada.

Taylor-MADE MEANS BETTER MADE IN AMERICA BY AMERICANS

The New Taylor Fulscope Controller protecting America's power to produce with **not 1 but 5** *forms of control.*

Taylor

Indicating Recording Controlling

TEMPERATURE, PRESSURE, FLOW *and* **LEVEL INSTRUMENTS**

YES..! IN EVERY INDUSTRY LUBRIPLATE *SPEEDS* DEFENSE

On land—on sea—in the air—in every phase of industry vital to defense, LUBRIPLATE lubricants are doing jobs that are nothing short of amazing. From a smear on the worm screw of the naval officer's binoculars to a ton of LUBRIPLATE in the dredge underwater gear case—against friction and wear—thwarting rust and corrosion—conserving bearings and parts—LUBRIPLATE carries on.

In spite of heat and high water—tractors and trucks rolling through muck and mud—spotless food packing machines constantly washed with scalding water—textile spindles whirling faster than ever before—marine equipment exposed to highly corrosive seawater and spray—LUBRIPLATE lubricants perform under conditions that would stop ordinary lubricants cold.

LUBRIPLATE DIVISION
FISKE BROTHERS REFINING COMPANY
SINCE 1870
Newark, N. J. Toledo, Ohio
DEALERS FROM COAST TO COAST

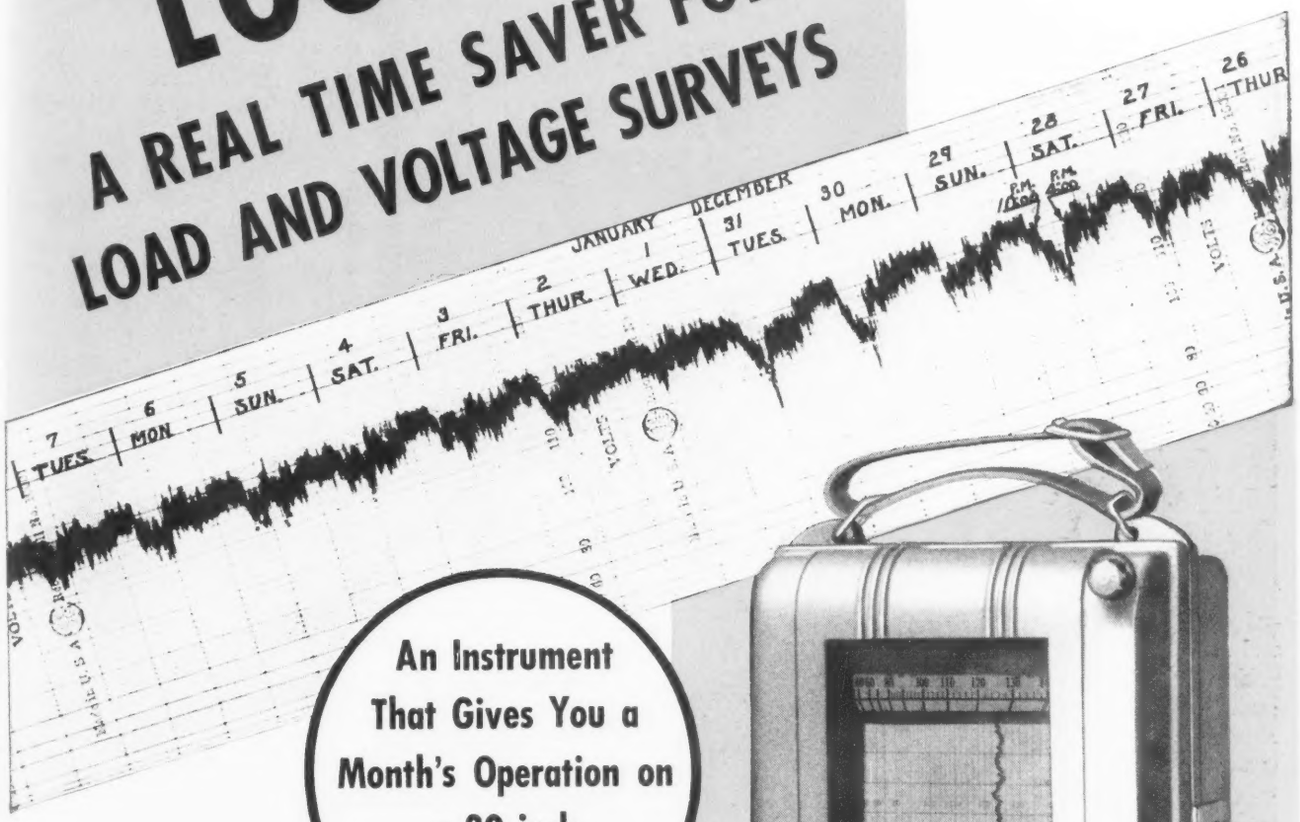
LUBRIPLATE

"Its the Film"

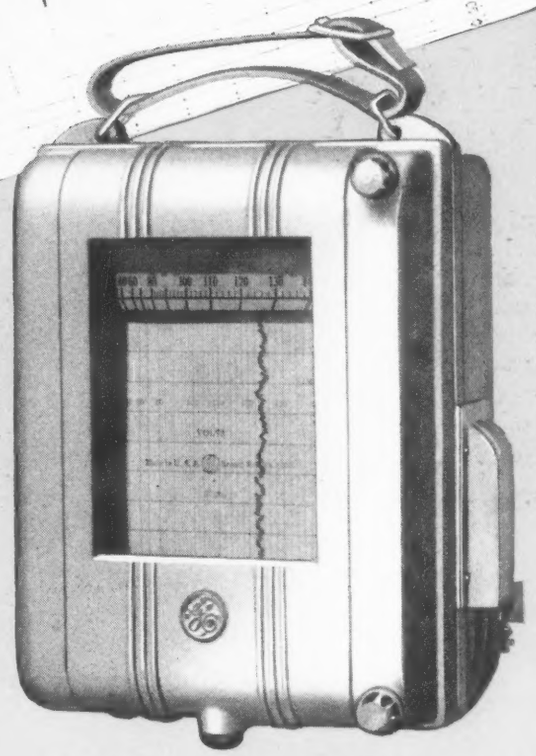
THE MODERN LUBRICANT *that Arrests Progressive wear*

LOOK!

A REAL TIME SAVER FOR LOAD AND VOLTAGE SURVEYS



An Instrument That Gives You a Month's Operation on a 30-inch Chart



Type CF-1 low-chart-speed recorder
(both ammeters and voltmeters are available)

WHEN analyzing load or voltage surveys, it is no longer necessary to reel off 60 ft of strip chart, or to examine a number of round charts. This new instrument gives you a 30-day operating record on a 30-in. chart—thus you can quickly check current or voltage conditions for an entire month, or for any 24-hr period.

A 4-day record can be seen through the glass window. This makes it possible to check the record without opening the instrument and unrolling the chart.

IT'S INKLESS—REQUIRES NO ATTENTION

This new instrument is an addition to our proved Type CF line of inkless recorders. It is the inkless feature that makes possible the one-inch-per-day chart speed. At such a low speed, an ink recorder would form pools of ink that would blot out the record.

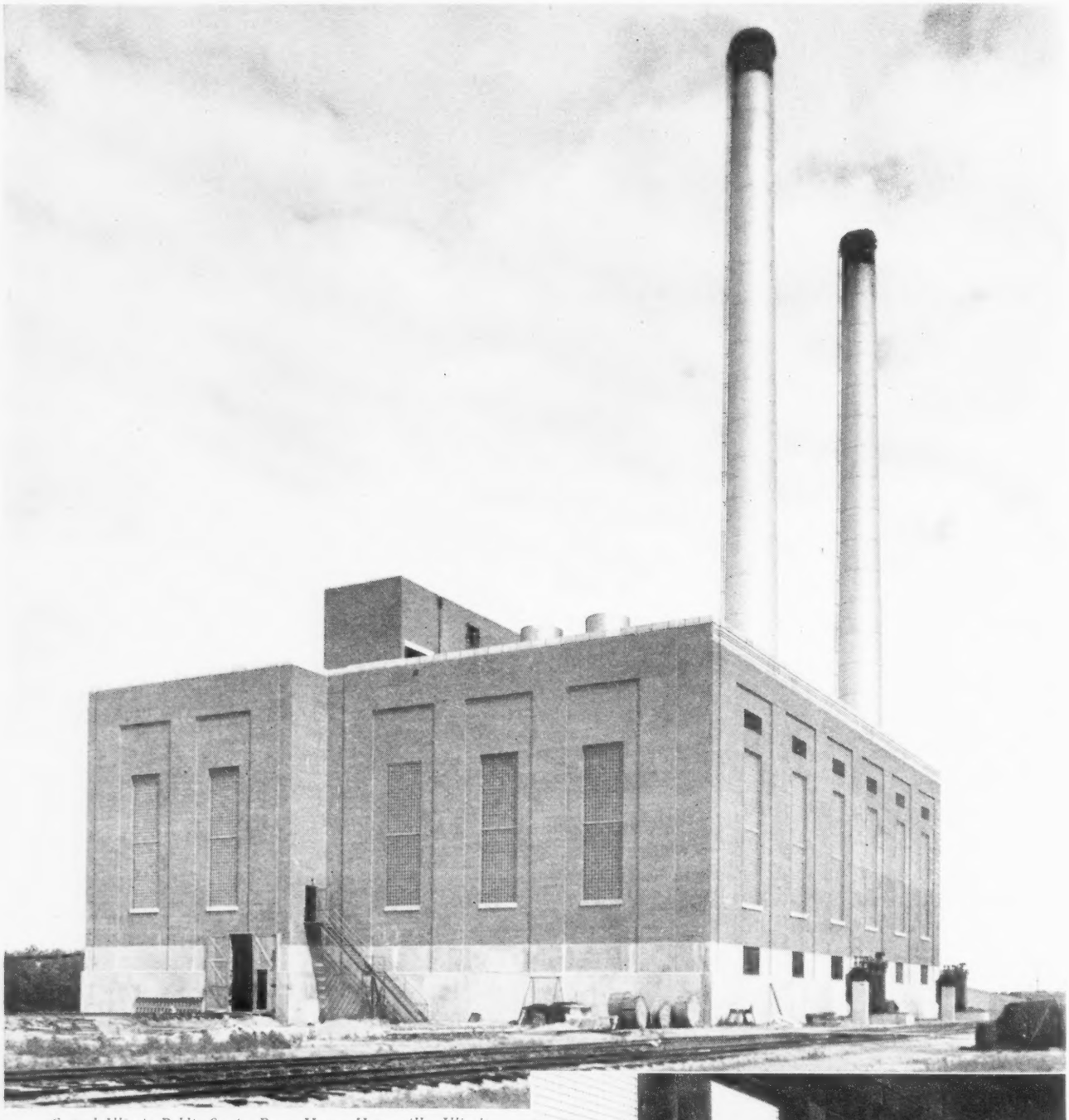
The inkless feature also enables the instrument to operate for a month without any attention, because the old troubles of pen clogging and ink freezing or evaporating are eliminated. Accurate in extremes of temperature—from −10 F to 120 F.

This instrument will be a worth-while addition to your testing equipment and should soon pay for itself in the time it saves. Bulletin GEA-3187 gives complete information. General Electric Company, Schenectady, N. Y.

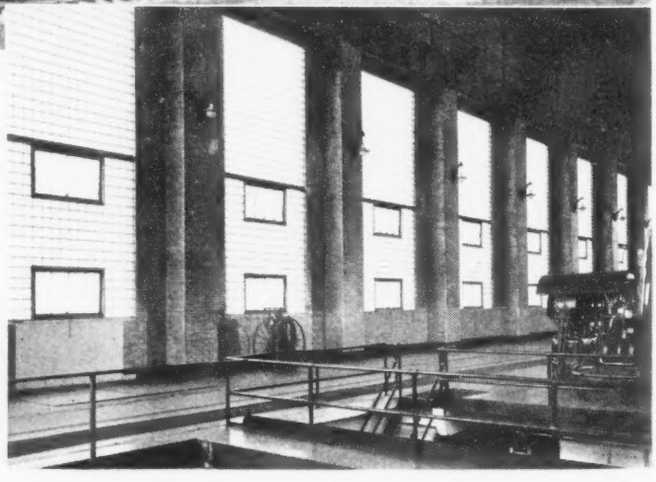
HEADQUARTERS for ELECTRICAL MEASUREMENT

GENERAL ELECTRIC

Why INSULUX Glass Block are the



Central Illinois Public Service Power House, Hutsonville, Illinois
Sargent & Lundy, Inc., Engineers, Chicago

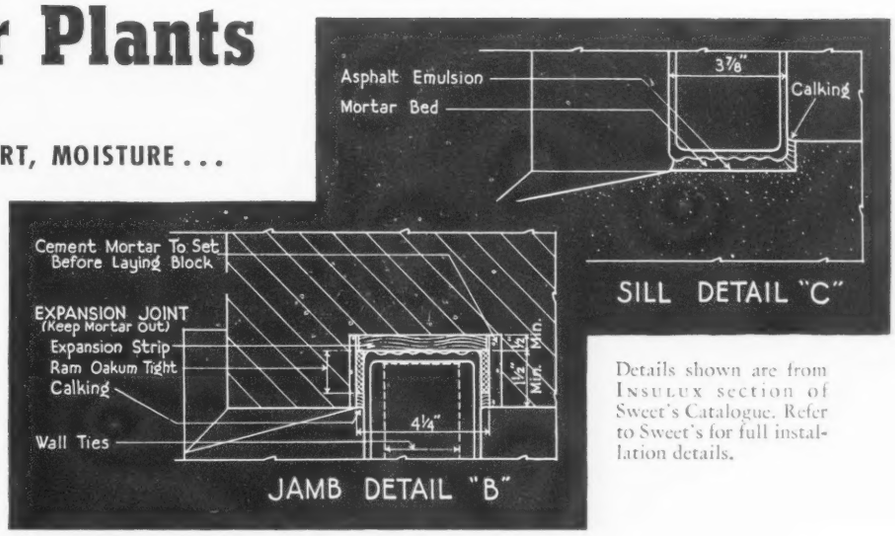


SAVE PRIORITY METALS BY USING INSULUX!
YOU GET PROMPT DELIVERY ON INSULUX GLASS BLOCKS!

Perfect Light-Transmitting Material for Power Plants

INSULUX KEEPS OUT DUST, DIRT, MOISTURE . . .

Daylight gets through INSULUX Glass Block, while dust, dirt, moisture stay out. In details shown at right, study the head, sill, and mortar joint details. Note the typical tight sealing of panels with asphalt emulsion, calking, oakum, and mortar.



Details shown are from INSULUX section of Sweet's Catalogue. Refer to Sweet's for full installation details.

INSULUX GIVES YOU BETTER CONTROL OF CONDITIONS INSIDE THE POWER PLANT . . .

The high insulating value of INSULUX panels permits large light-transmitting areas without excessive heat transfer. Each INSULUX Glass Block provides two thicknesses of glass, with dead-air space between. INSULUX is approximately twice as efficient as sash in maintaining even inside temperature.

INSULUX PANELS PROVIDE CONTINUOUS WALL PROTECTION . . .

The power house is the nerve center of the industrial plant, vital to the Nation's welfare and defense. Continuous walls of sturdy INSULUX Glass Block furnish necessary protection from saboteurs and prowlers. INSULUX is translucent —guards privacy.

INSULUX PANELS MEAN LOWER MAINTENANCE COSTS . . .

No paint is needed—little cleaning is necessary. You avoid many of the difficulties met in the maintenance of tall, inaccessible light-transmitting areas. INSULUX panels can be *wiped* clean! There is nothing to rot or corrode, requiring replacement or repair.

INSULUX PERMITS FREEDOM OF POWER HOUSE DESIGN . . .

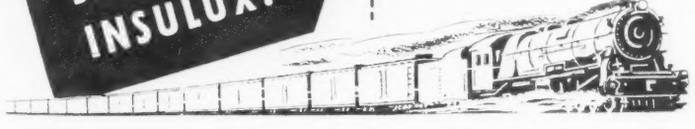
INSULUX Glass Block permit broad freedom in architectural planning. Old buildings can be remodeled with larger light-transmitting areas, without steel. New buildings are planned with better design, more usable daylighting and the functional advantages of unbroken wall construction.

OWENS-ILLINOIS

INSULUX

Glass Block

YOU GET PROMPT DELIVERY ON INSULUX!



MAIL THE COUPON FOR MORE INFORMATION

OWENS-ILLINOIS GLASS COMPANY, INSULUX Products Division,
Dept. 16, Ohio Building, Toledo, Ohio.

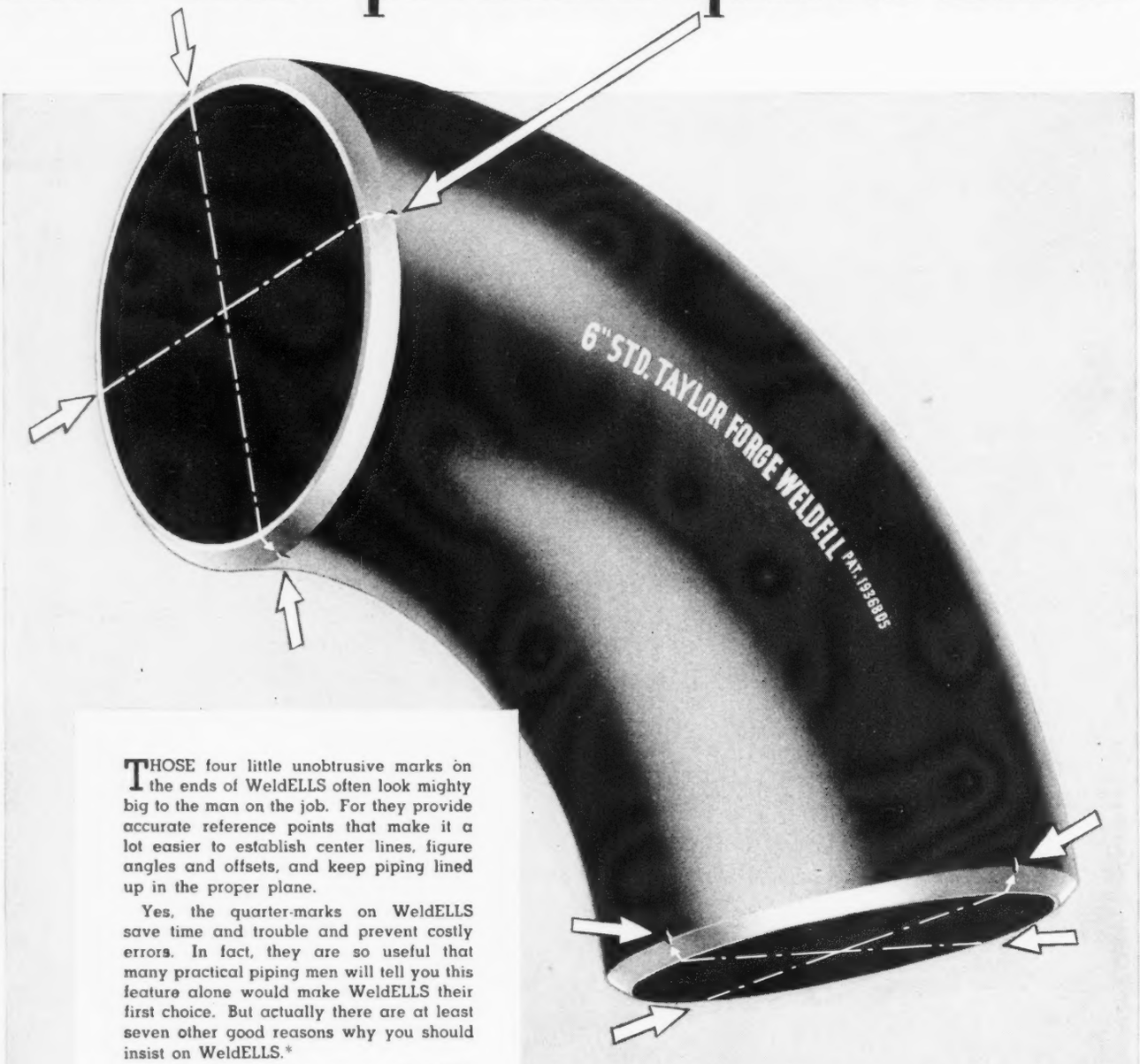
Gentlemen: Please send, without obligation, full information on INSULUX Glass Block.

Name .....

Address .....

City ..... State .....

WeldELLS *alone*
have these precision quarter-marks



THOSE four little unobtrusive marks on the ends of WeldELLS often look mighty big to the man on the job. For they provide accurate reference points that make it a lot easier to establish center lines, figure angles and offsets, and keep piping lined up in the proper plane.

Yes, the quarter-marks on WeldELLS save time and trouble and prevent costly errors. In fact, they are so useful that many practical piping men will tell you this feature alone would make WeldELLS their first choice. But actually there are at least seven other good reasons why you should insist on WeldELLS.*

Quarter-marks are an *exclusive* WeldELL feature—a typical example of the extra value you get in all Taylor Forge Welding Fittings and Forged Steel Flanges. Ask your local distributor for a copy of Taylor Forge Catalog No. 401.

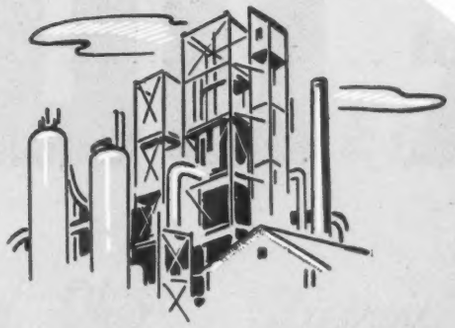
TAYLOR FORGE & PIPE WORKS

General Offices & Works: Chicago, P.O. Box 485
New York Office: 50 Church St.
Philadelphia Office: Broad Street Station Bldg.

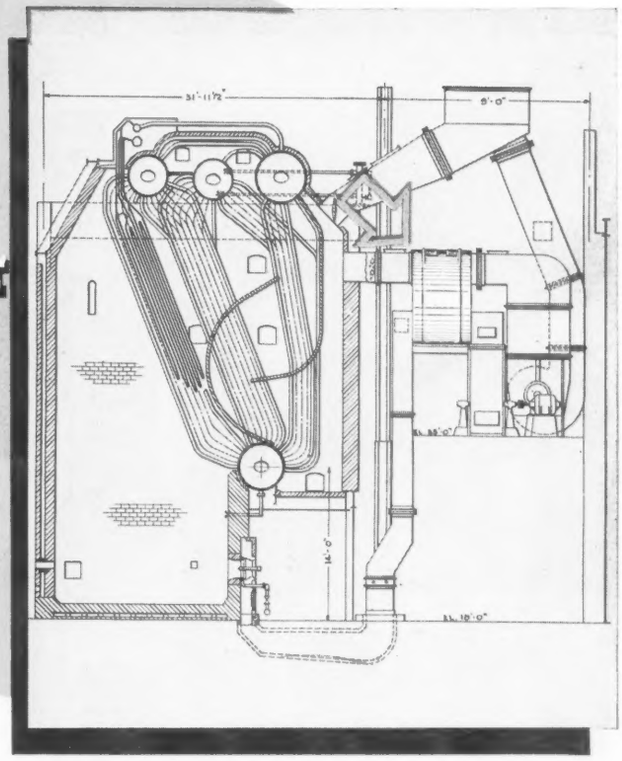
WeldELLS have *everything

No other fittings for pipe welding combine these eight features. Besides quarter-marks (described here) the features are:

1. **Seamless**—greater strength and uniformity.
2. **Tangents**—keep weld away from zone of highest stress—simplify lining up.
3. **Selective reinforcement**—provides uniform strength.
4. **Permanent and complete identification marking**—saves time and errors in shop and field.
5. **Wall thickness never less than specification minimum** — assures full strength and long life.
6. **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
7. **The most complete line of Welding Fittings and Forged Steel Flanges in the World**—insures complete and undivided responsibility.



A Fuel-Saving Answer To A "Burning" Question



FUEL IS SAVED for oil refineries by the flexibility and high efficiency of these modern steam generators, equipped with Ljungstrom Air Preheaters. » » » At a large oil refinery helping to meet one of the nation's most essential needs, modern steam generators like this are now in service. Each has a capacity rating of 104,000 lb. steam per hr. They are equipped with combination gas and oil burners, and their high efficiency in burning either type of fuel is enhanced by Ljungstrom Air Preheaters. At capacity rating, flue gases enter the preheater at 560° F., leave at 341° F., heating combustion air to 409°.

Because fuel costs may represent 20-30 per cent of the operating costs of an oil refinery, efficient combustion is *always* important. Right now, however, fuel saving has a greater significance, measured in terms of the national welfare.

In recent years, many foresighted oil refineries have re-examined the economics of power-plant operation giving greater weight to fuel conservation. In this program, the use of combustion air preheated in *Ljungstrom continuous regenerative counterflow units* has contributed materially to fuel economy.

These compact heat-transfer units save space and save steel. Their mechanical dependability has been established in service on some of the nation's outstanding power plant installations. They protect the continuous availability of the boiler for service, as maintenance can be quickly accomplished in scheduled outage periods, or even postponed in an emergency.

Facts and figures are available on the performance of Ljungstrom Preheaters for large or small boiler plants, for industrial or utility service, using any type of fuel. Write for them today.

THE AIR PREHEATER CORPORATION

Executive Offices: 60 East 42nd St., New York, N. Y. **Plant: Wellsville, New York**

LOOK OUT FOR RUST

IT'S no news to you that rust can play havoc with turbines. A year ago there wasn't much you could do about it. Then came *new* Shell Turbo Oil. Now a field-tested, service-proved turbine oil that has made history . . . the first to meet all 3 vital needs of modern turbine lubrication . . .

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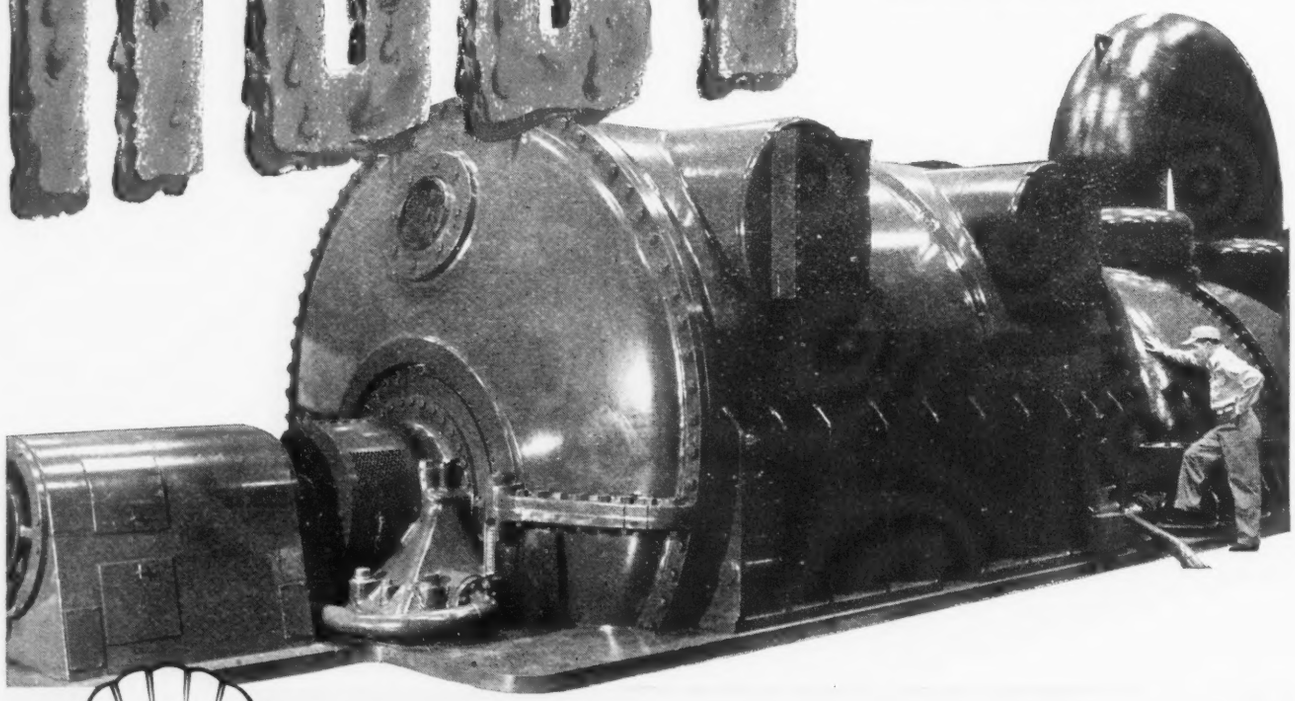

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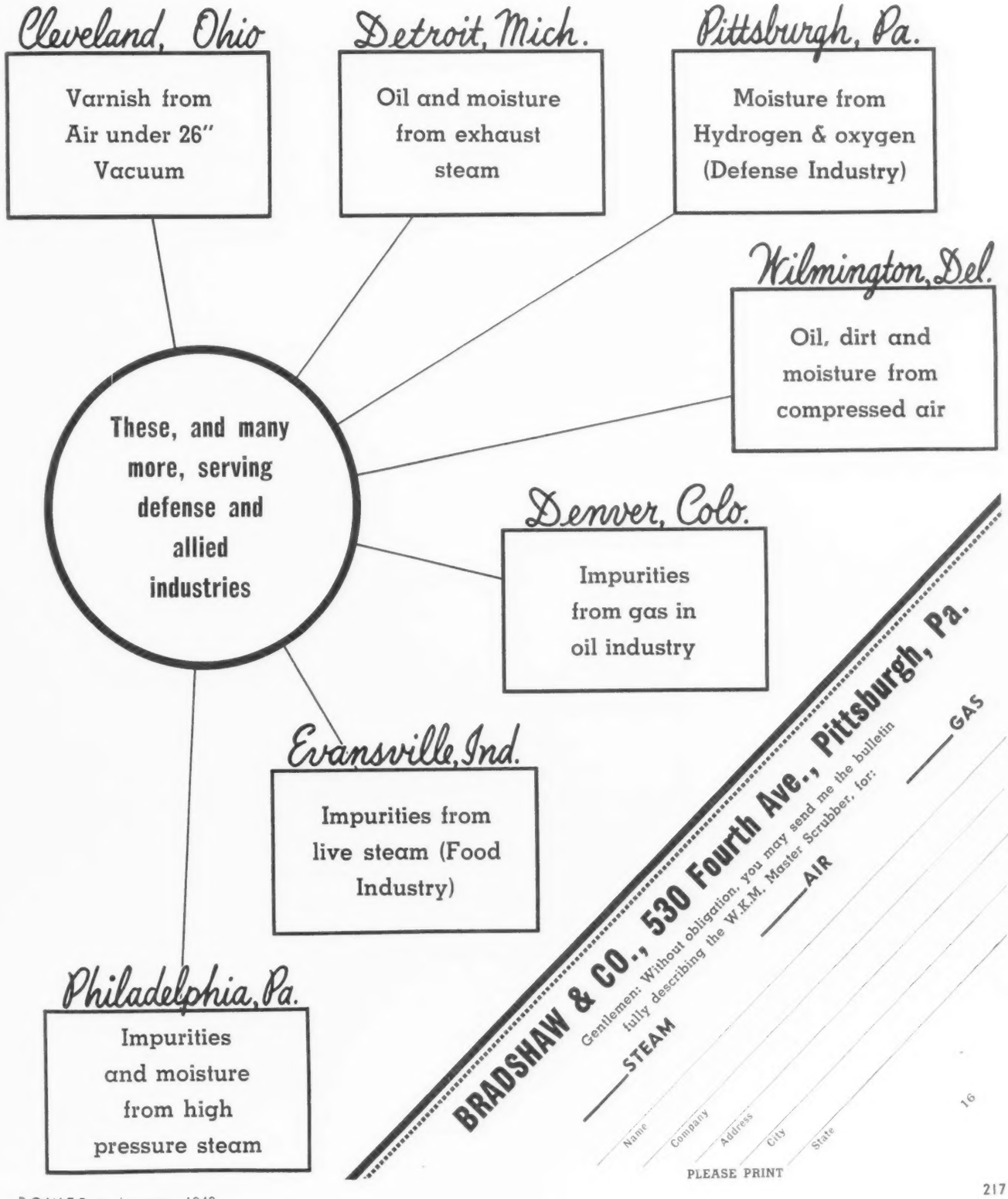
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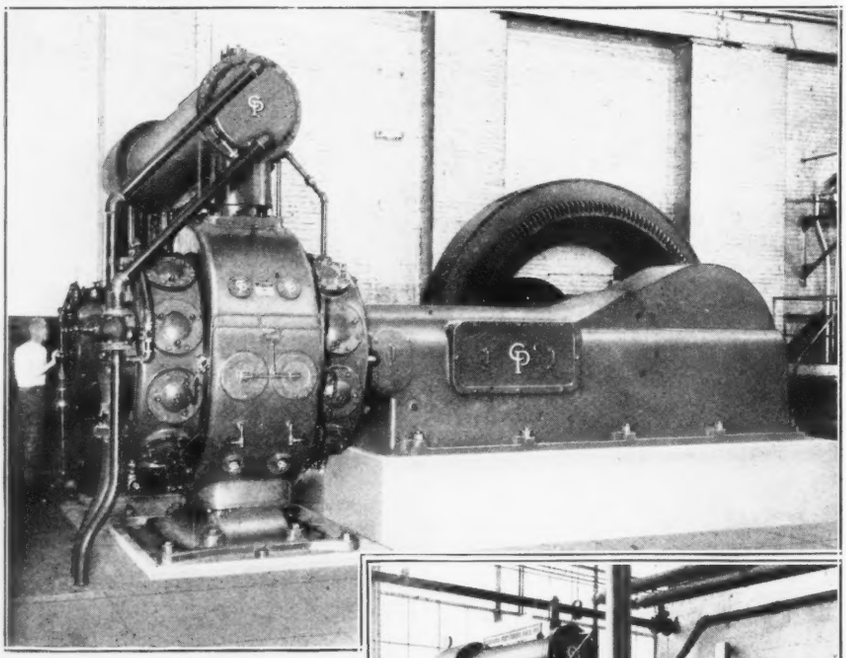
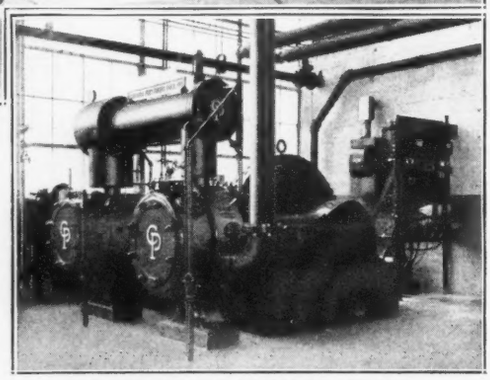
16

O-CE COMPRESSORS TO DEFENSE PLANTS



↑ **WITHIN A FEW MONTHS,** thirty-five Chicago Pneumatic O-CE Horizontal-Duplex Compressors were installed in well-known shipyards. This popular compressor is available in capacities of 350 to 10,000 c.f.m.



SYNCHRONOUS MOTOR-DRIVEN → O-CE Compressor, 800 c.f.m. piston displacement, in well-known aircraft plant. Simple, efficient, five-step regulation varies the output to meet load.

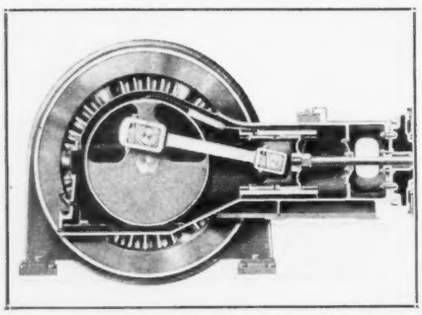
EIGHT 6,000 C.F.M. COMPRESSORS RUSHED TO EASTERN SHIPYARDS

Model Noted For Dependability

NEW YORK—Familiar equipment in new shipyards, aircraft factories and other defense plants are Chicago Pneumatic O-CE Horizontal-Duplex Compressors. Sound in design and ruggedly built, these popular compressors are ideal for continuous, heavy duty operation. The large effective area of their well-known Simplate Valves insures minimum power consumption. Their five-step regulation, low maintenance cost, outstanding reliability and other CP features make them the logical selection for plants which must have dependable, 24-hour-a-day air power.

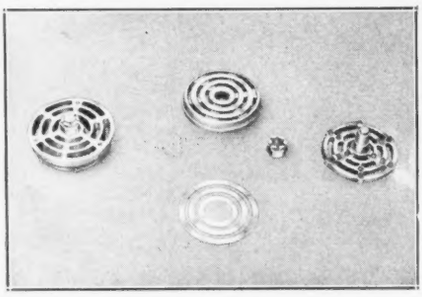
CHICAGO PNEUMATIC TOOL COMPANY

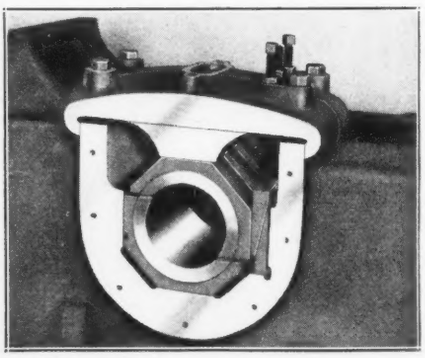
General Offices: 6 E. 44th St., New York, N. Y.



↑ **CP FLOOD SYSTEM OF LUBRICATION** assures maximum reliability. No pump or other working parts to fail and endanger running gear; no small oil lines to clog. This method provides all bearings with a copious supply of oil which also serves as a coolant and returns to the pump to be used again.

ACTUAL MEASUREMENTS PROVE that CP Simplate Valves, with their annular ports and straight, uniform lift, possess the greatest effective area for a given valve diameter, thus assuring lower power consumption. Straight valve lift, together with low air velocities resulting from large effective area, account for the remarkable endurance of these valves. ↓





↑ **MAIN BEARINGS** of two-piece design are easy to align and adjust—vertically by shims, and horizontally by wedges. Can be adjusted with the machine in operation; can be removed and replaced without lifting out the shaft.

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AIR COMPRESSORS

ALSO: Pneumatic Tools, Electric Tools, Rock Drills, Hydraulic Aviation Accessories, Diesel Engines

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STATIONARY
AIR OR GAS
MOTOR DRIVEN
STEAM DRIVEN
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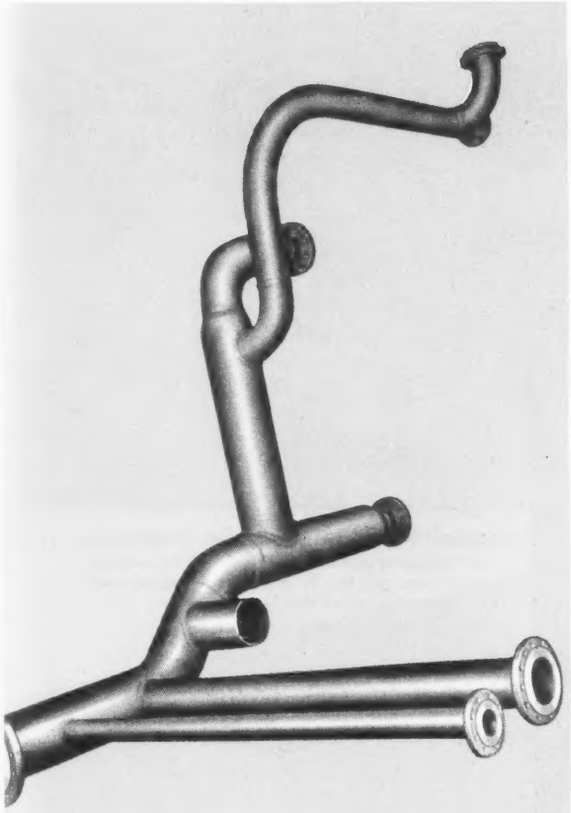
Pre-Fabricated PIPING IS Better PIPING

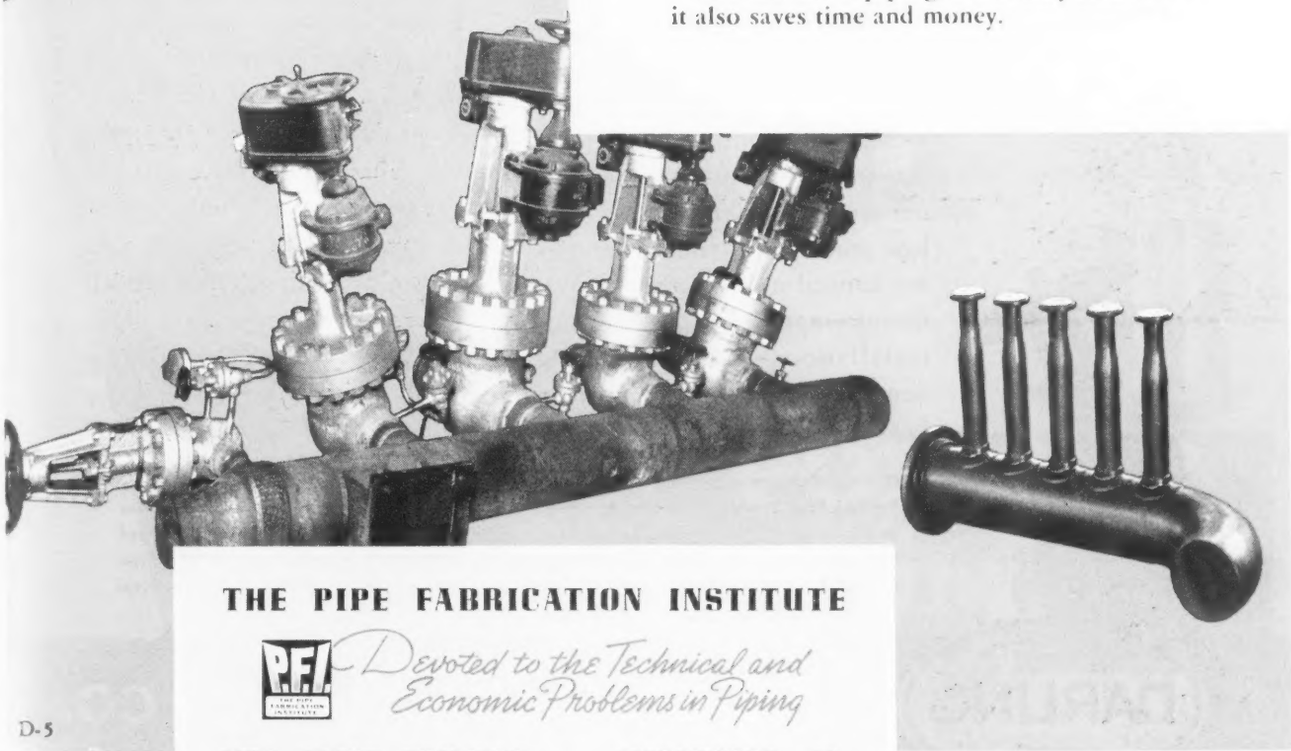


Pre-fabricated piping is piping prepared by a qualified fabricator and delivered to the job as a series of sub-assemblies that permit easy, rapid and economical installation.

The qualified pipe fabricating plant employs experienced mechanics and pressure welders whose work can be insured. Layout tables, form cutting machines, work rotating fixtures, straightening tables, pre-heating and stress relieving equipment, testing facilities, etc. (not usually available in the field), offer further assurance of superior quality.

Specialized piping experience over many years enables the qualified fabricator to contribute suggestions which assure sub-assemblies that are commercially practical. Such sub-assemblies are shop tested, accurately aligned, thoroughly cleaned and inspected . . . all important to a satisfactory job.

Pre-fabricated piping is not only better . . . it also saves time and money.



D-5

THE PIPE FABRICATION INSTITUTE

P.F.I. *Devoted to the Technical and Economic Problems in Piping*

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At your service are the engineers of the Darling Valve & Manufacturing Co. Working with actual field problems for over 40 years, this staff has met and solved almost every possible type of valve problem—perhaps the very one you are faced with now. Their service is yours without cost or obligation. Write or call the Darling Valve & Manufacturing Co., Williamsport, Pa.

Darling offers you a quality line of longer-lasting Gate Valves. They come in Fully Revolving Parallel Seat Double Disc, also in Taper Seat — Slotted and Solid Wedge types. In service pressures up to 3000 pounds, you can get Darling Gate Valves in Cast Iron, Bronze, Forged Steel, Cast Steel, and Corrosion Resistant Alloys. Darling also manufactures Compression Type Fire Hydrants, Check Valves, Motor and Cylinder Operated Valves, and many accessories.

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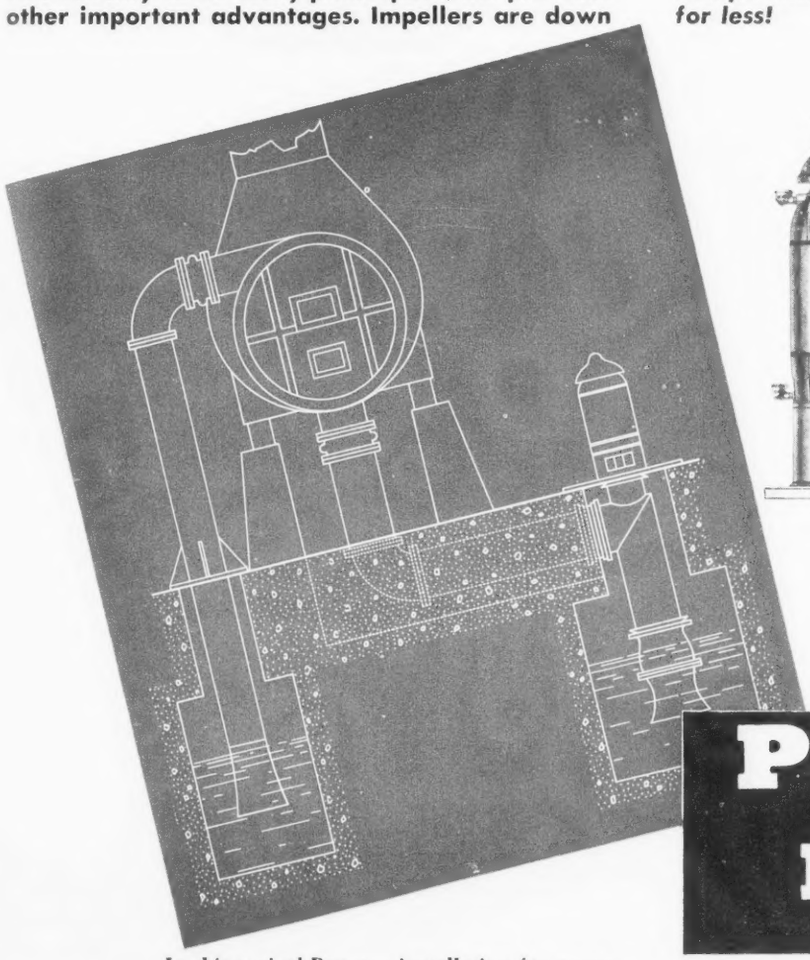
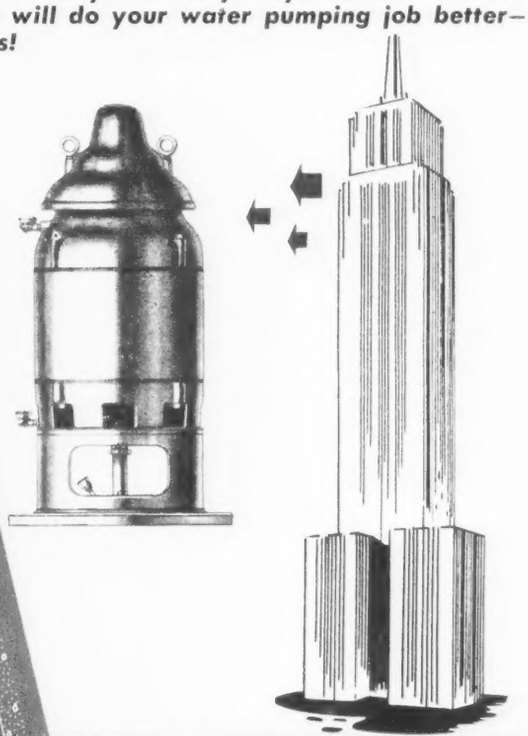
WITH PUMPS OF OUTMODED DESIGN?

POMONA VERTICAL PUMPS are as compact and space-saving as a modern skyscraper. Instead of wasting valuable floor space with complicated piping...and with shafting, motor and pump spread "broadside"...Pomona Pumps operate *vertically*. They require only the small compact space occupied by the motor head. Shaft and pump impellers are down in the sump or tank, completely out of the way.

This not only saves costly plant space, but provides other important advantages. Impellers are down below water level, instantly ready to go *without priming*. Shaft and bearings are in the water stream, completely lubricated by the water being pumped, eliminating maintenance and oiling at these points. And the piping is simplified, for the discharge can be placed at, above—or *below*—floor level . . . wherever is most convenient for maximum compactness and plant efficiency.

Find out today the many ways Pomona Vertical Pumps will do your water pumping job better—for less!





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PUMPS

In this typical Pomona installation for pumping condenser cooling water, note small floor space required —still further reduced by sub-surface discharge line. In addition, Pomona's steep head-capacity characteristics insure more uniform cooling action, better condenser efficiency. Send for engineering bulletin explaining why.

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Speed Ranges up to 16 to 1
Sizes 1 to 30 hp.

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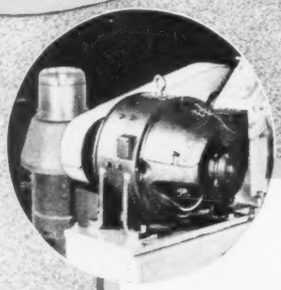
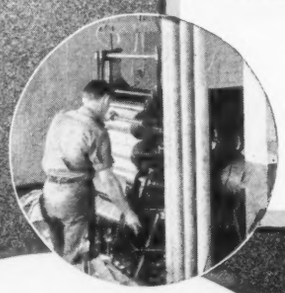


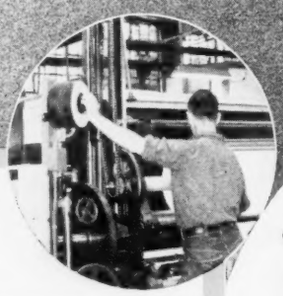
POWER

Plenty of it, applied directly without intermediate speed-changing devices.

SAFE SPEEDS FOR THREADING AND INCHING

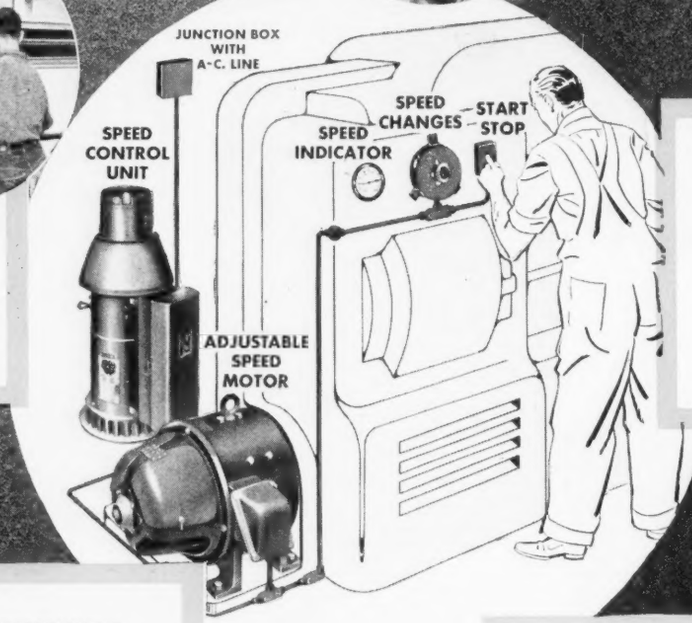
The drive can be arranged to give very slow speeds while threading material by hand or setting up work.





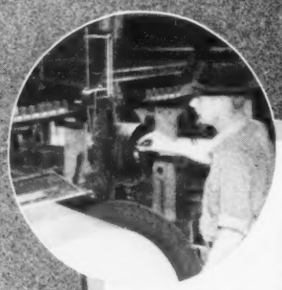
SPEED CHANGES

Smooth changes over ranges up to 16 to 1. Wider ranges under special conditions . . . Speeds can be adjusted while machine is in operation.



QUICK STOPPING

Obtained electrically either by operation of speed adjuster handle or *stop* button.



CONTROLLED ACCELERATION

Torque is provided to suit the job. No clutches are needed. Acceleration is smooth so that driven machine and material in process are not subjected to undue shock or strain.

SPEED SETTING

When set for a given operation the motor may be stopped and started without interfering with the speed setting.

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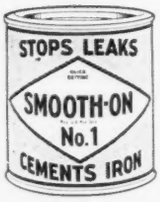
to help maintain production schedules

This repair consists of simply tamping a stiff putty of Smooth-On No. 1 into the crack. No dismantling, heat, or special equipment is necessary.



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Stops Leaks

Tightens Loose Parts

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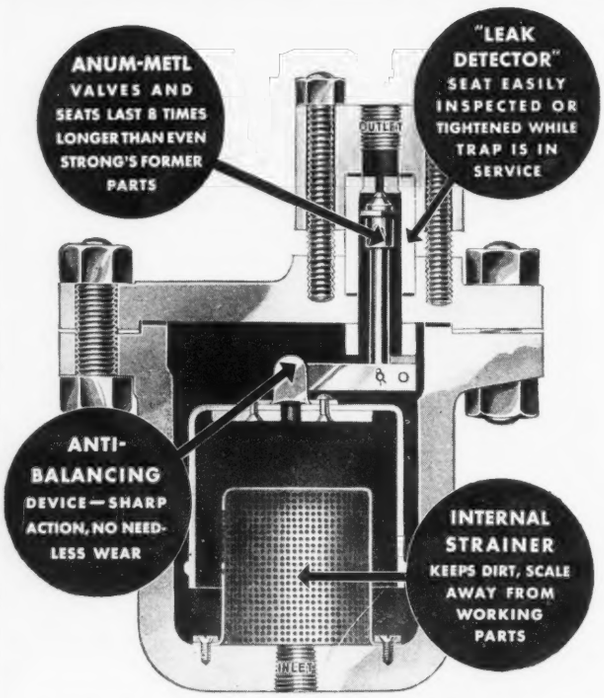
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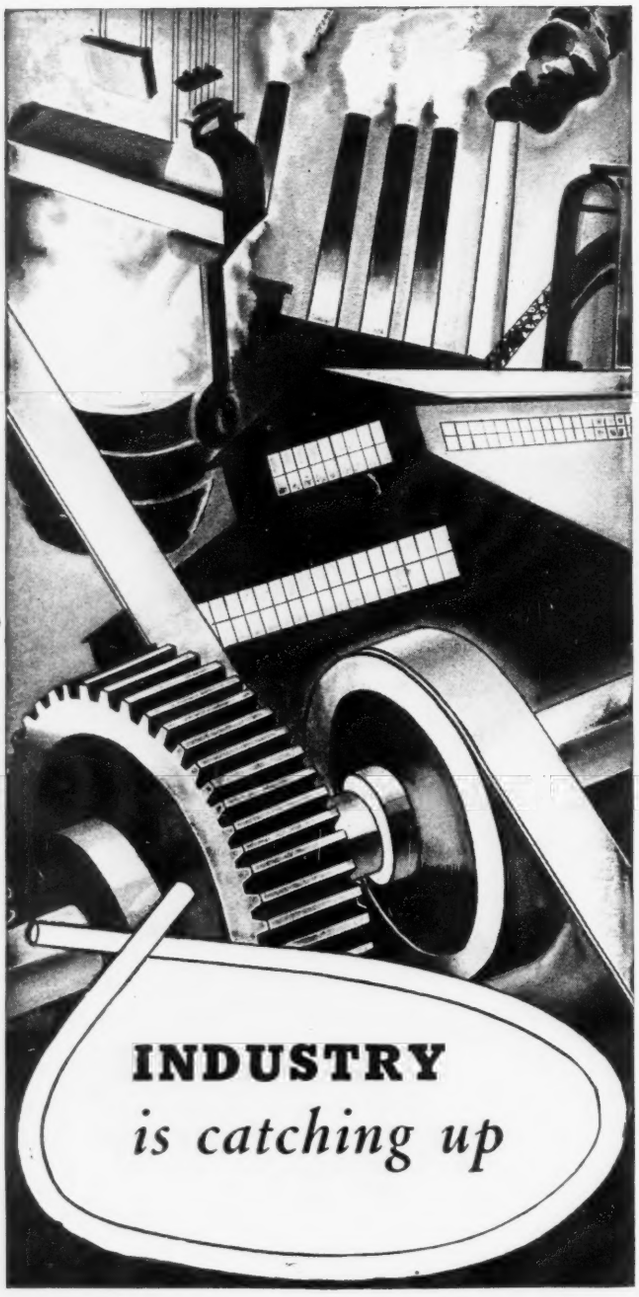

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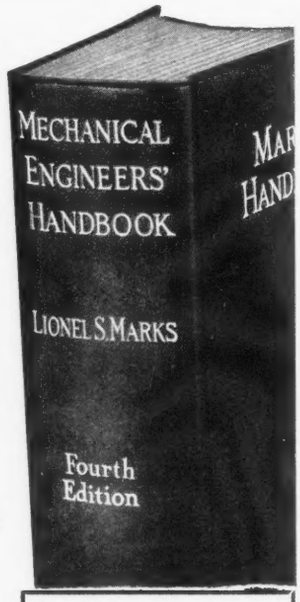

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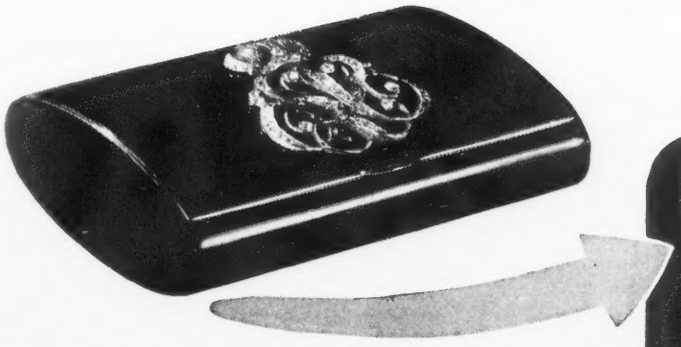

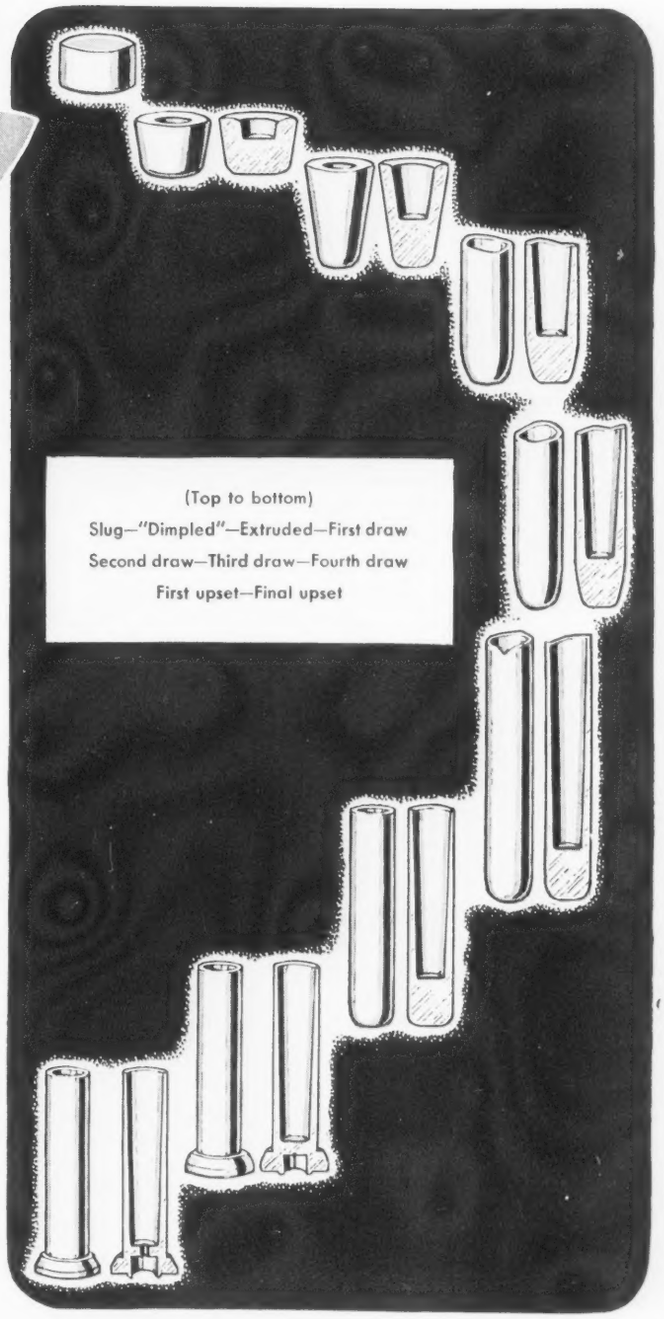

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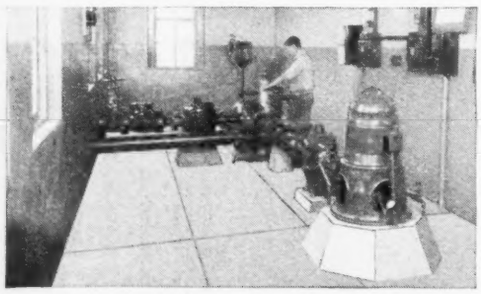

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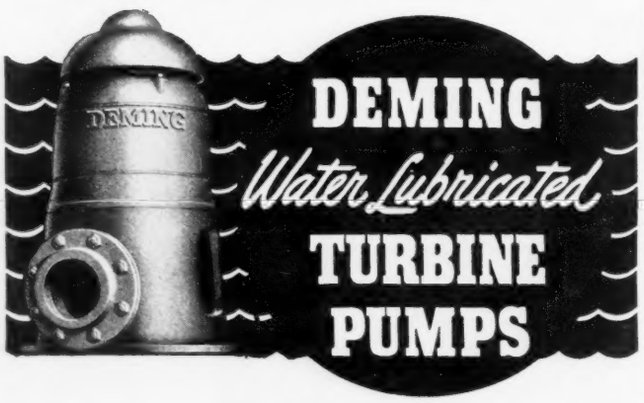

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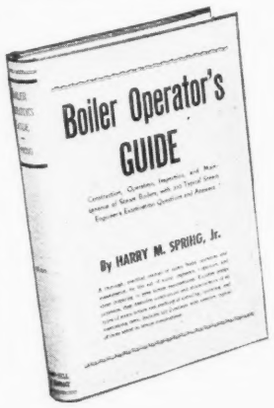

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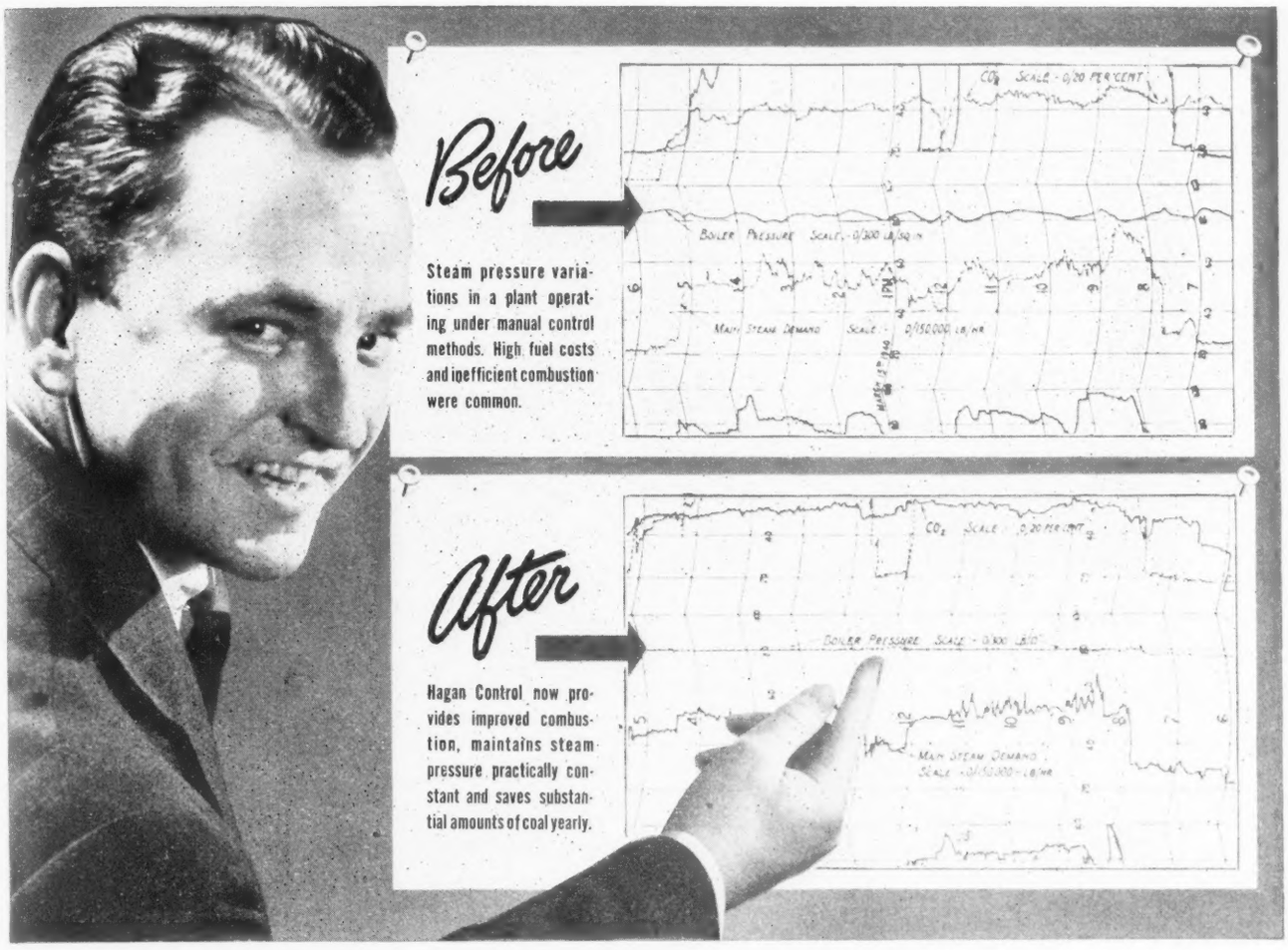
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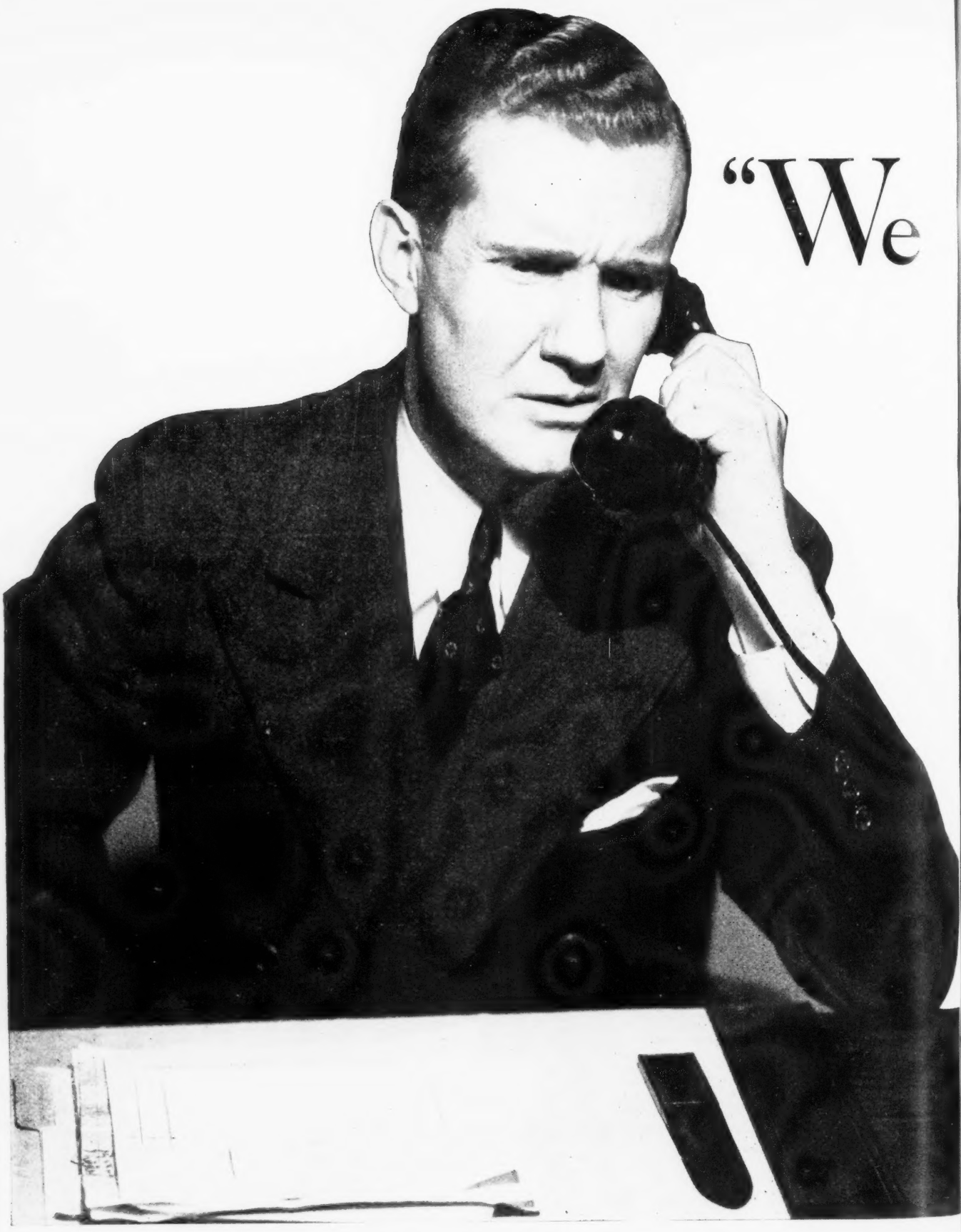

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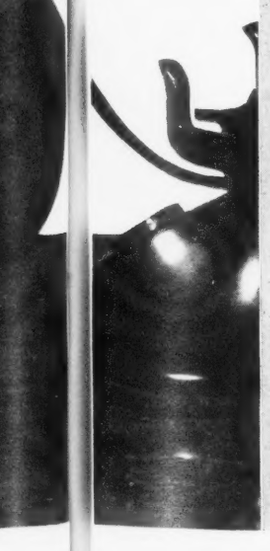

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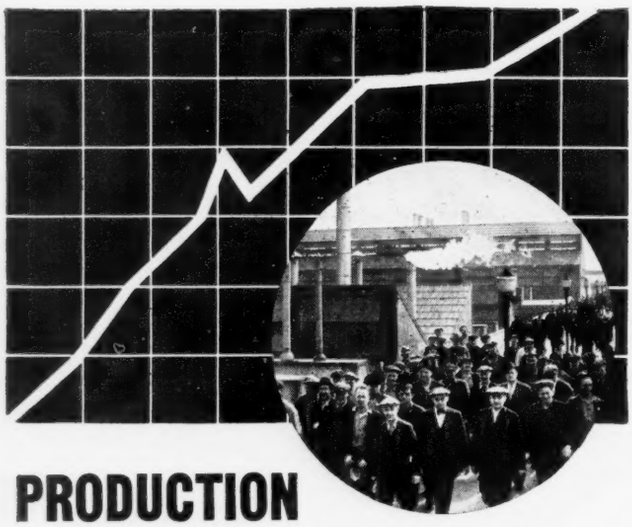

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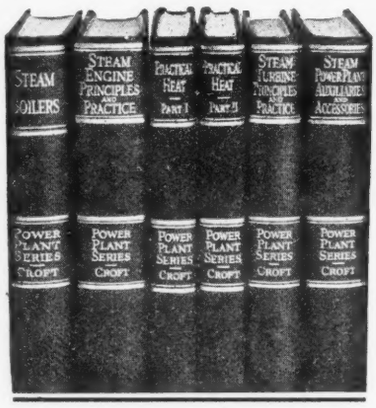

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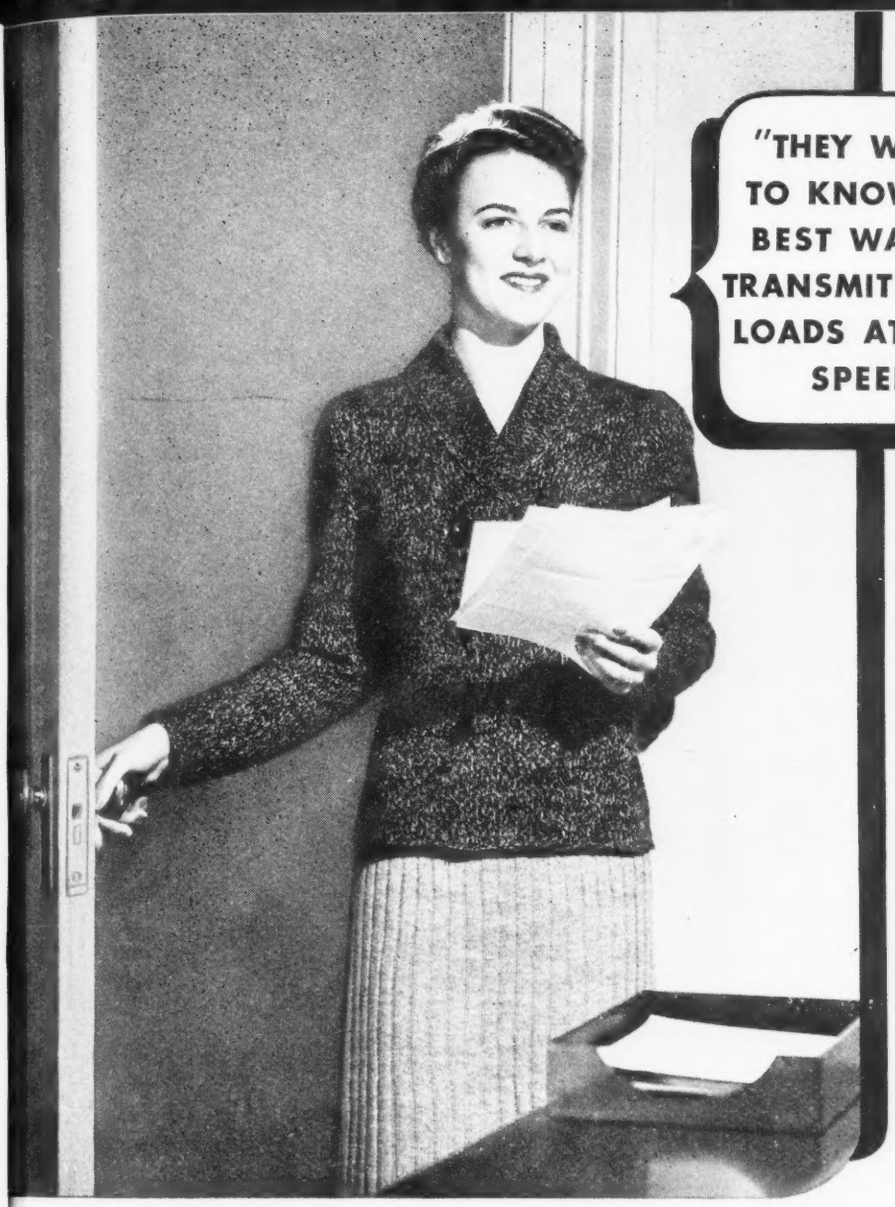

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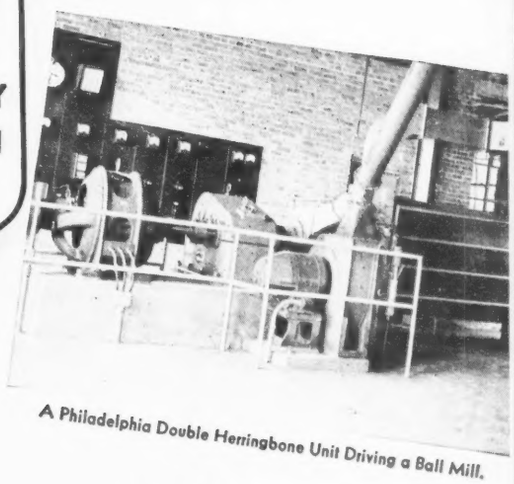

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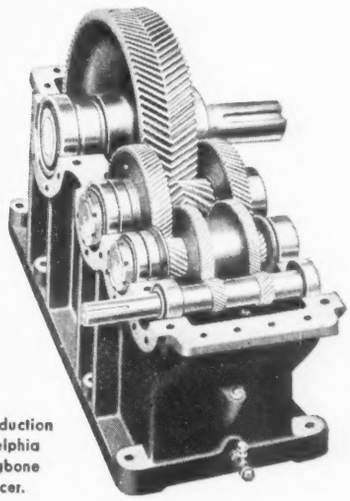

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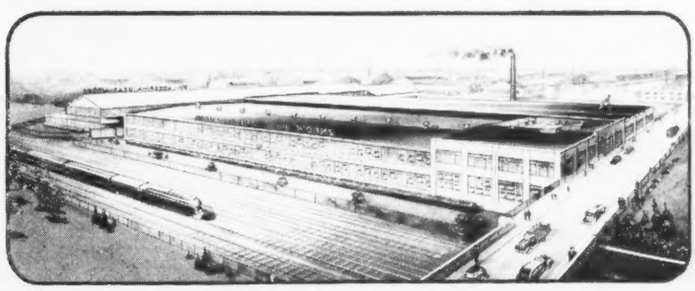

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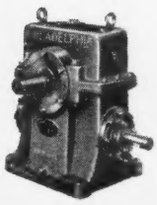

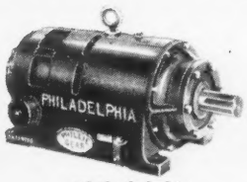

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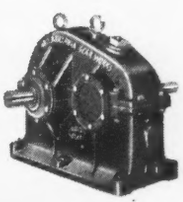

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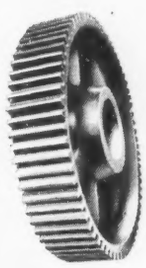

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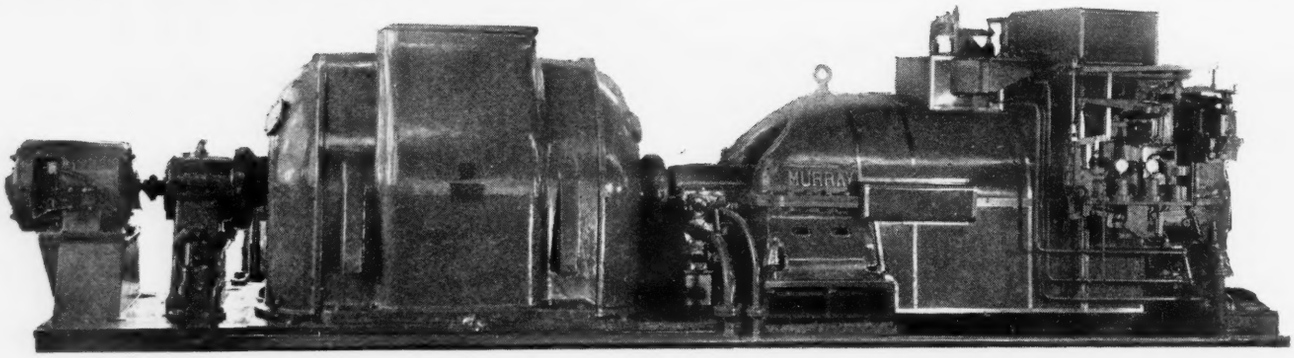

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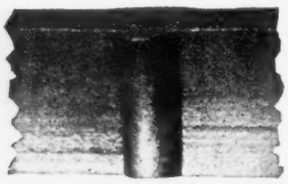

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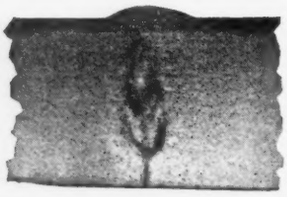

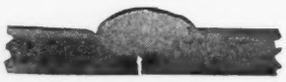

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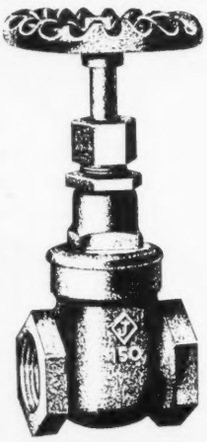

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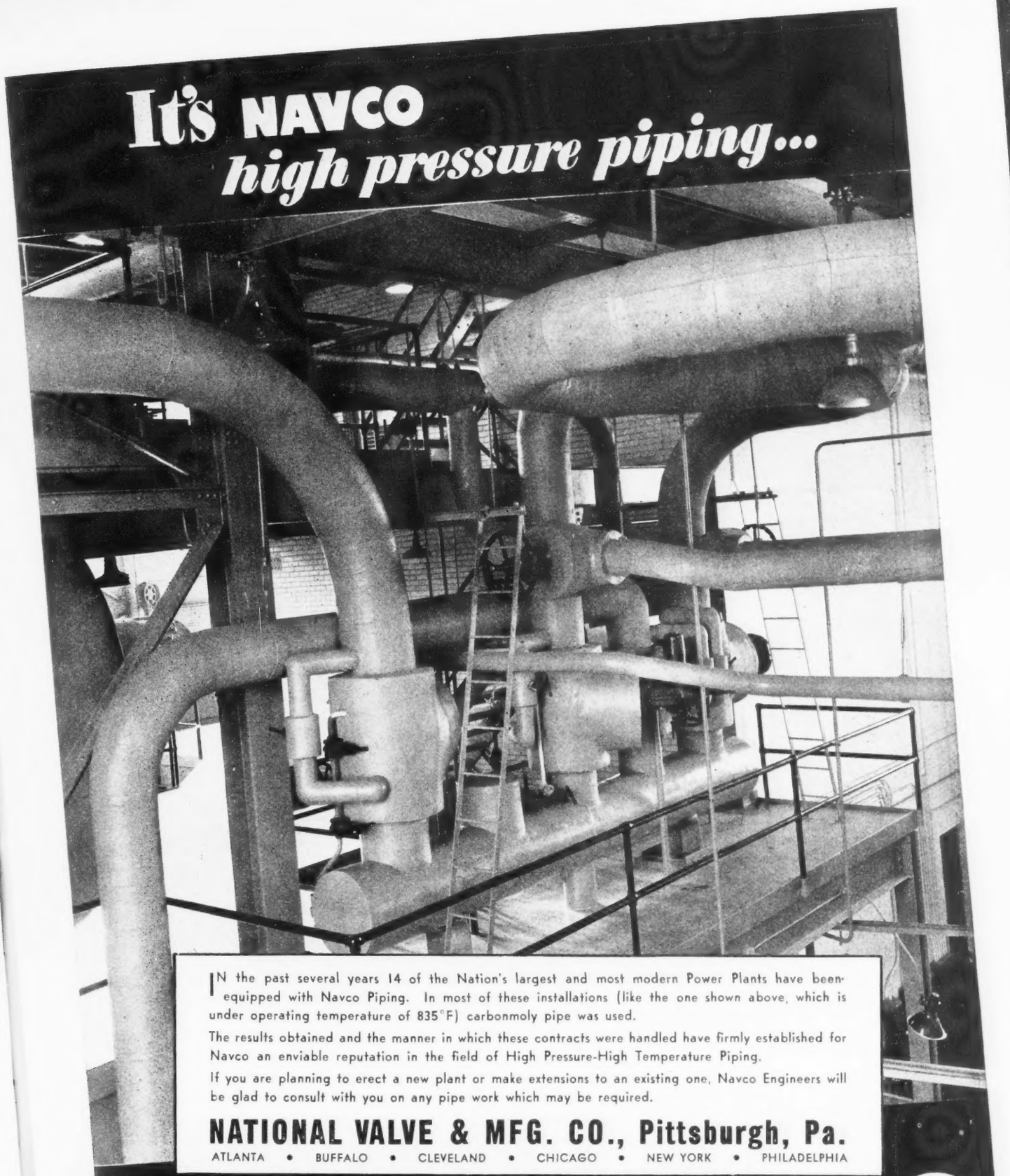

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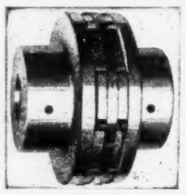

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Made for all sizes of ammonia, air and gas compressors.
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SAVES $600.00
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For free analysis of raw boiler water send jugful of boiler water to SUHM CO., INC., 1942-50 S. Kinnickinnic Ave., Milwaukee, Wisconsin.
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Experiment takes time — so why not save time by calling in a specalist who has already gone over the ground you are now exploring?

POWER, meeting place of power men in all parts of the country, points the way to the solution of many power problems through its Professional Service Section.

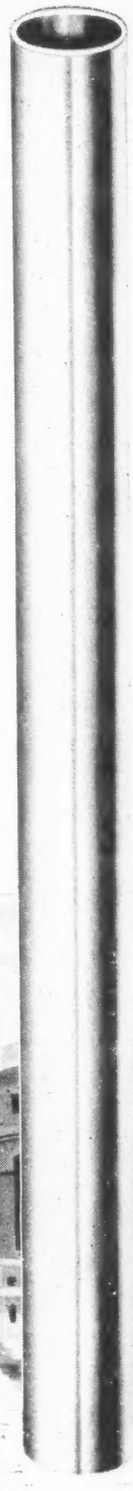
Why not tell one of these specialists about your problem?

G-L-O-B-E SPELLS SAFETY AND SAVINGS IN PRESSURE TUBES

Service records in many of the nation's noteworthy power plants — their use by leading railroads, industrial and marine boiler builders — attest the greater value, safety and savings of Globe Steel Tubes.

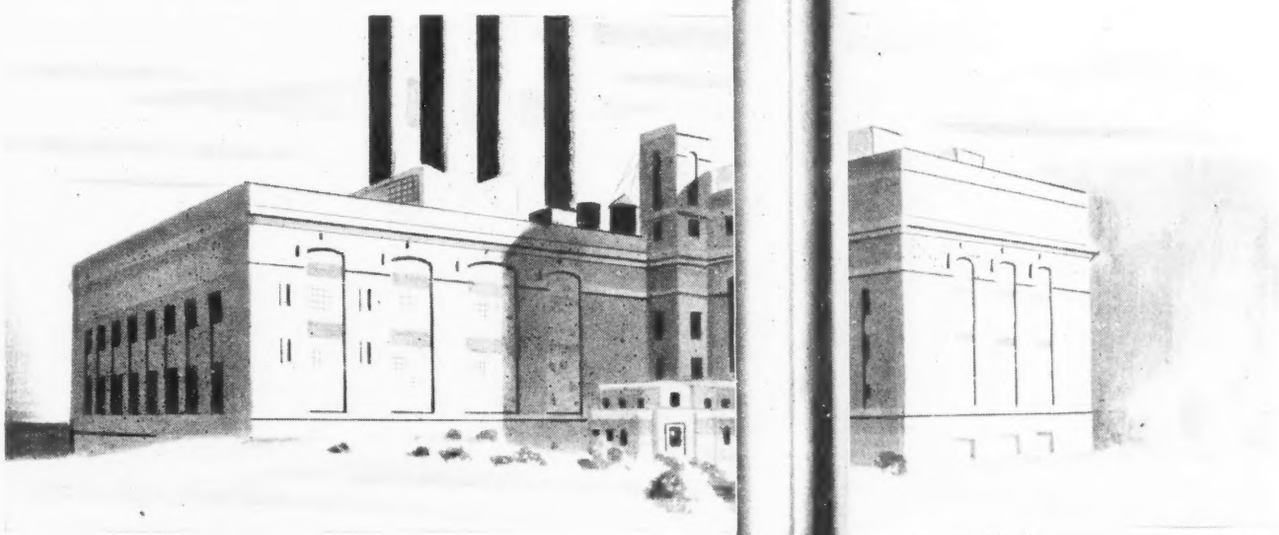
Their extra margin of safety and strength — particularly vital to meet modern high pressure and temperature demands — more than offsets any immediate advantage of lower first cost.

GLOBE STEEL TUBES CO.



Globe engineers are always available to assist in selecting a tube with the exact characteristics you require.

MILWAUKEE, WIS.



1000

GLOBE TUBES

GLOBE STEEL TUBES

- Stainless Tubes
- Condenser and Heat Exchanger Tubes
- Boiler Tubes
- Mechanical Tubing

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*PALMETTO PACKING keeps pumps running

Profit by the experience of the many plant engineers who have matched Palmetto against other packings, and have found that abundantly lubricated Palmetto runs longer with less frequent repacking . . . without danger of scored shafts . . . without reducing pump efficiency.

That's why engineers who have tried Palmetto standardize on it for all steam, hot water and air services.

FREE test SAMPLE

Make the test yourself without cost or obligation. Just send us your name and address on a postal card, mentioning the size of the packing and the service. A generous working sample will be sent to you . . . FREE!

*Reg. U. S. Pat. Off.

GREENE, TWEED & CO.
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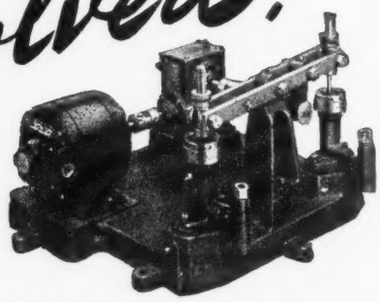
PALMETTO
for steam, hot water, air.
PALCO *for water.* PELRO *for oils.* CUTNO *for alkalis.* SUPERCUTNO *for acids.* KLERO *for foods, etc.* PALMETTO SUPERSHEAT
PACKINGS

9 out of 10 who try them, buy them

YOUR BOILER SCALE PROBLEM CAN BE Solved!



The pump pictured is one of nine types in the Hills - McCanna Line. Over 200 sizes are available. All pumps are positive displacement type, accurate to ±1½%. Drives can be arranged to suit conditions.

•

WATER treatment must be adjusted to meet changing conditions of the water. When you treat the water, naturally you must be sure you are right . . . adding the correct dosage according to what the chemist finds.

Hills - McCanna Chemical Proportioning Pumps provide a readily adjustable automatic means of injecting re-agents. They can be "hooked-up" with your intake lines, working synchronously whenever you add water in the boilers. They're inexpensive and dependable.

Let us go over your boiler water treatment problem with you. Write today.

HILLS-McCANNA CO., 2369 Nelson St., Chicago

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McGRAW-HILL PUBLICATIONS
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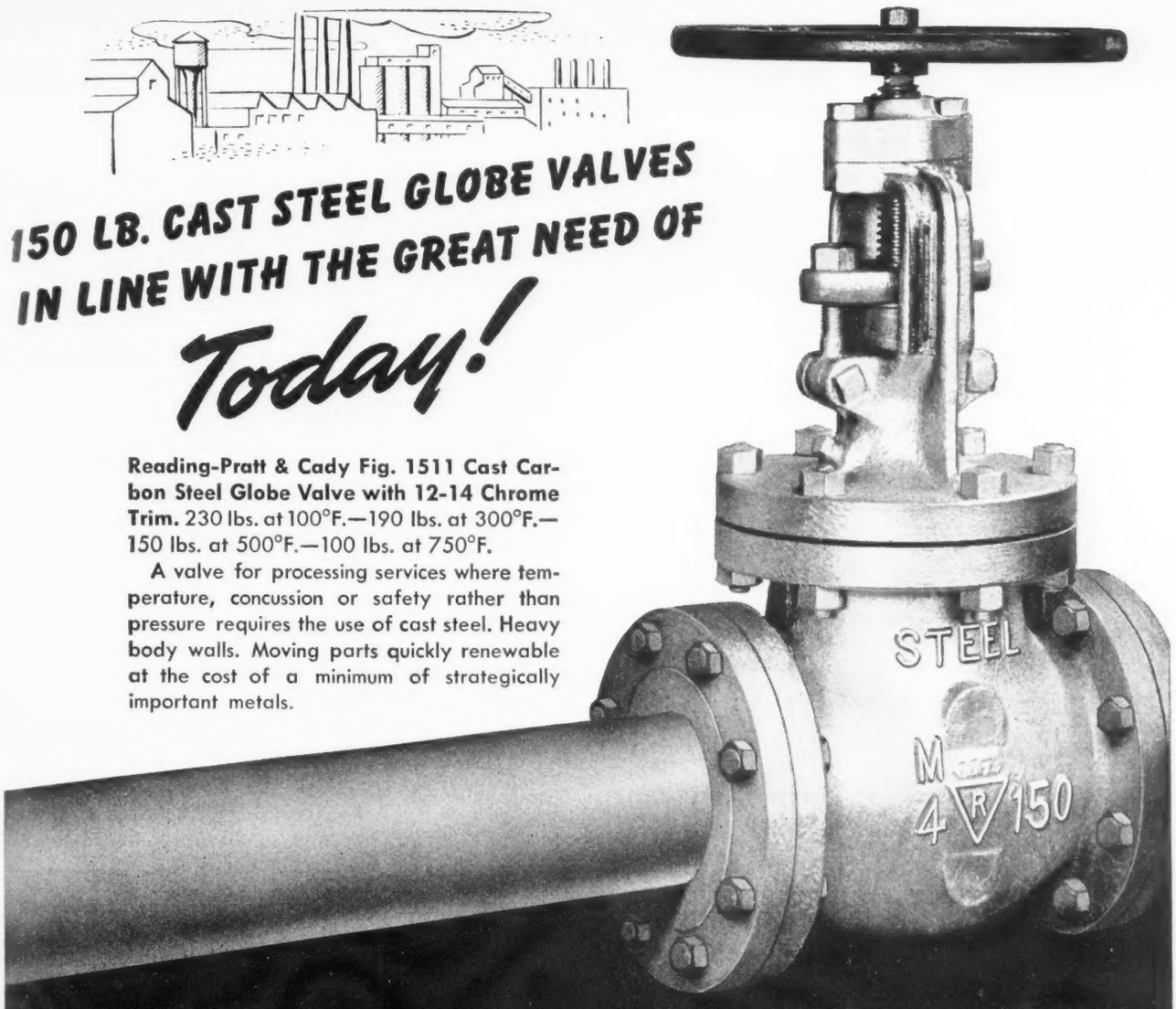
150 LB. CAST STEEL GLOBE VALVES IN LINE WITH THE GREAT NEED OF *Today!*



Reading-Pratt & Cady Fig. 1511 Cast Carbon Steel Globe Valve with 12-14 Chrome Trim. 230 lbs. at 100°F.—190 lbs. at 300°F.—150 lbs. at 500°F.—100 lbs. at 750°F.

A valve for processing services where temperature, concussion or safety rather than pressure requires the use of cast steel. Heavy body walls. Moving parts quickly renewable at the cost of a minimum of strategically important metals.

Materials are scarce! Conserve them by installing valves which under the gaff of twenty-four-hour operation do not require early replacement and the repeated use of critical materials.

Before buying new valves, take advantage of renewable features. Replace worn parts and continue to use the critical metals in parts still serviceable.

Valves are vital to defense. Our capacity, now fully absorbed by defense work, has been increased and further increase made possible by the recent consolidation of our facilities at Reading, Pa. While scarcity of materials slows the outward flow of production, our position is now very much stronger than it was before the consolidation.

READING—CAST STEEL VALVES AND FITTINGS
PRATT & CADY—BRASS AND IRON VALVES
D'ESTE—VALVE AND ENGINEERING SPECIALTIES

READING-PRATT & CADY
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MIDWESTERN DISTRICT MANAGER WANTED

Leading nationally known accessory manufacturer operating in Diesel and internal combustion engine field wants District Manager to locate in Chicago. Must have engineering background and proven sales record, preferably in midwestern territory and in Diesel field. Permanent connection for the right man.

Also opening in head office located in East for sales engineering correspondent. Write giving full qualifications.

P-225, Power
330 West 42nd St., New York City

POSITIONS VACANT

M.E. GRADUATES not over 40 for design and assembly layout of boilers and accessory equipment. Knowledge of descriptive geometry and thermodynamic calculations very helpful. Location, Middle West and East. Applications must include full resume of schooling, firms worked for and details of experience. P-146, Power, 330 W. 42nd St., New York, N. Y.

GRADUATE MECHANICAL ENGINEERS preferably under 40 with practical experience in boiler-room operation and knowledge of combustion problems. No applications considered unless accompanied with complete history of applicant's background and experience. P-147, Power, 330 W. 42nd St., New York, N. Y.

MANUFACTURER OF VALVES for industrial and water supply service would like to obtain engineer with steel or cast iron valve design experience. Location Eastern New York State. Reply in full. P-227, Power, 330 W. 42nd St., New York, N. Y.

EMPLOYMENT SERVICE

SALARIED POSITIONS, $2,500 to $25,000. This thoroughly organized advertising service of 32 years recognized standing and reputation carries on preliminary negotiations for positions of the caliber indicated above, through a procedure individualized to each client's personal requirements. Several weeks are required to negotiate and each individual must finance the moderate cost of his own campaign. Retaining fee protected by a refund provision as stipulated in our agreement. Identity is covered and, if employed, present position protected. If your salary has been $2,500 or more, send only name and address for details. R. W. Bixby, Inc., 270 Delward Bldg., Buffalo, N. Y.

FREE BULLETIN

NEW CATALOG on Rebuilt Power Equipment, 32 pages, 4"x9", Classified, indexed and illustrated. Write to Chicago Electric Co., 1320 W. 22nd St., Chicago, Ill.

PRICE & COMPANY

CONSULTING ELECTRICAL AND MECHANICAL ENGINEERS

Technical Advisers to the Purchasers of Used Steam and Electrical Equipment

Inspection Redesign Reports
Installation Supervision

88 Broad Street, Boston, Massachusetts

ADELBERT B. PRICE
Registered Professional Engineer

Immediate Shipment!

2—200 KW **Westg. Syn. Motor Generator Sets,** 600 V. D.C., Gen., connected to 290 H.P. Synch. motor 3/60/2200 and 900 RPM, with exciters and controls

1—1000 KW **Turbine type Generator,** 3/60/2300 3600 RPM, Type ATB 2

1—25 KW **Westg. Turbine and Generator,** 125 V. D.C., 3500 RPM

5—50 H.P. **G.E. Unused** Slip Ring Type MTC **Hoist and Crane Motors,** 600 RPM, 3/60/440.

8—50 H.P. NEW **Allen-Bradley Reversing Type Controllers,** self-contained, 3/60/440 V.

1—100 H.P. **Allis Chalmers Induction Motor** 1750 RPM, 3/60/2200

4—50 H.P. & 100 H.P. **Electric Solenoid Brakes,** 3/60/440

1—700 GPM, 200′ hd. electric motor driven **Manistee Water Pump,** 3/60/2200.

IRON & STEEL PRODUCTS, INC.
13488 So. Brainard Ave., Chicago, Illinois
"*Anything* containing IRON or STEEL"

UNDERWRITERS FIRE PUMPS

5—1,000 GPM Centrifugal Fire Pumps with AC motors either 220-440-2200 v.

TIDEWATER EQUIPMENT & MCHY. CORP.
305 MADISON AVE. NEW YORK, N. Y.

VOLTAGE REGULATORS

—"increased load, desired voltage at all load demands, lower operating cost" all due to voltage regulators furnished by you having solved our former troubles"
- - - - - - - - - (name upon request)

NEW & REBUILT automatic voltage regulators of all makes for all size DC and AC generators at money saving prices. Prompt shipments. Write your problems today.

Liberal allowance on your old regulator.

Electrical Instrument Exchange
411 N. Ashland Ave. CHICAGO, ILL.

All Makes - Types - Sizes

QUICK
DEPENDABLE
LOW COST
GAUGE & VALVE
REPAIRS

UNIVERSAL STEAM GAUGE CO.
285 Broadway, Cambridge, Mass.

BOILERS

(some complete plants)

2—300 H.P., 180# 3 drum, low head, bent tube, pulverizers. Water walls. Complete plant.
2—400 H.P., 250#, 3 drum, bent tube, side dump stokers.
2—400 H.P., 160#, 4 drum, bent tube, pulverizers.
1—350 H.P., 200#, cross drum, box header, stoker.
1—450 H.P. 250#, bent tube, under feed stoker.
1—480 H.P., 200#, cross drum, hand or oil fired.
2—360 H.P., 160#, 3 drum, low head, bent tube, pulverizers, rear water arch walls, complete plant.
Babcock & Wilcox, sectional header—4—300 H.P., 2—200 H.P., 4—150 H.P.

H. P. BREARLEY
3423-91st Street, Jackson Heights, N. Y.

SPECIAL BARGAIN

2—50 HP NEW Diehl Type K10 230 V DC 600/1350 rpm Comp'd. interpole drip-proof bare motors in original factory crates.
1—150 HP Westinghouse CW Slip Ring 3-60-440 V—600 rpm bare motor.

Sandman Electric Motor Company
49 Purchase St. Boston, Mass.

AC GENERATORS

1—225 KVA, 600 r.p.m., 2300-V, G.E.
1—225 KVA, 900 r.p.m., 2300-V, G.E.
1—125 KVA, 900 r.p.m., 2400-V, Westghse.

CARSON
MACHINE & SUPPLY COMPANY
Box 4547, Capitol Hill Sta,, Oklahoma City, Okla.

FOR SALE

STOKER

Illinois Forced Draft Chain Grate Stoker with all accessories. Suitable for burning bituminous coal. 150 sq. ft. grate surface, Drive 10 HP, 220 Volt motor coupled to Reeves Drive. #8 American forced draft fan and 5¼ x 6 American blower engine included.

FS-226, Power
330 West 42nd St., New York City

WANTED

WANTED TO BUY

TURBO-GENERATOR

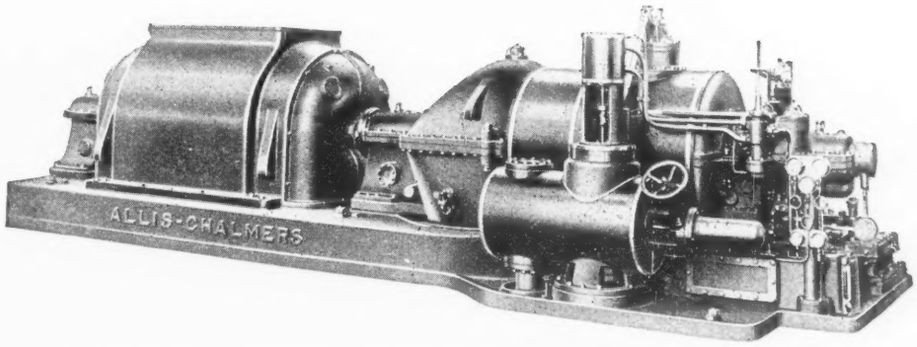
One (1) Turbo-generator, approximately 1500 Kw., 2300 V., 3 Ph., 60 C., 275 lbs. steam pressure, 700 degrees heat, with surface condenser.

CALDWELL ENGINEERING CO.
Jacksonville, Illinois.

DEPENDABLE

Turbo-Generators

It is the Practice of this Company to Confine its Inventory Strictly to Comparatively Modern, Little Used Turbines Some Are Practically New



2—Allis-Chalmers, 2500-KVA, 3/60/600-volt, 200#-P, 500°F-TT, Surface Condensers

PART OF OUR INVENTORY—BELOW

1—G.E., 7500-KVA, 3/60/600-2300-v, 250# 575° Maximum. Surface Condenser.

1—G.E., 5000-KVA, 3/60/2300-v, 250# 550° F. Surface Condenser.

1—Allis-Chalmers 4000-KVA, 3/60/2300-v, 200#, 500°-F, TT, Condensing.

1—G.E., 1875-KVA, 3/60/480-v, 200#, 500°, Condensing.

1—G.E., 1563-KVA, 3/60/2300-v, 175#, 100° SH, 28". Surface Condenser.

1—Westinghouse, 1563 KVA, 3/60/2400 volts, 200#, 100° SH. Condensing, Modern.

1—Allis-Chalmers 1250-KVA, 3/60/2300-v, 200#, 500° TT. Surface Condenser.

1—G.E., 1250-KVA, 3/60/480-v, 175#-P and 16# Abso. Mixed Pressure.

1—G.E., 937-KVA, 3/60/2300-v, 200#, 500°-TT, 3-Stage Condensing.

1—Allis-Chalmers, 937-KVA, 3/60/2300-v, 200#, 500°-TT, Condensing Surface Condenser.

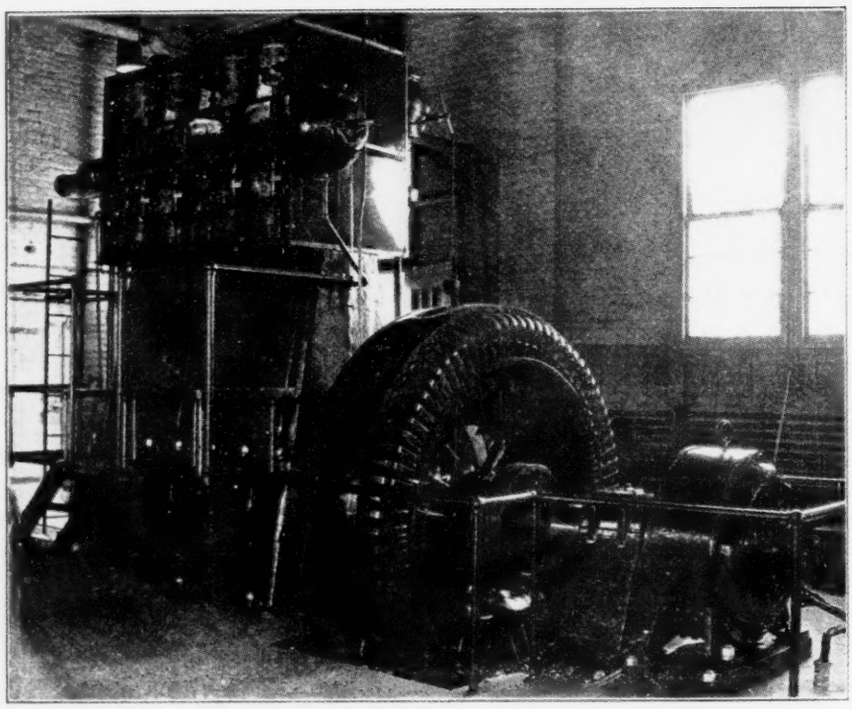
1—G.E., 625-KVA, 3/60/2300-v, 200#, 500° TT. Condensing.

1—G.E., 625-KVA, 3/60/600-v, 250#, 550° F-TT, Condensing Modern.

WILMS, WEAVER & CO. Union Guardian Bldg. DETROIT, MICH.

We Deal In Turbo-Generators Exclusively

ELECTRICAL POW



Actual Photograph

625 KVA AMES VERTICAL UNIFLOW UNIT

625 KVA Westinghouse alternating current generator, 3 phase 60 cycle 2300/600/480/240 volts 300 RPM direct connected to 14"x16" Ames 4 cylinder vertical uniflow non-condensing engine, 150-175 lbs. steam pressure 0-5 lbs. back pressure. Complete with exciter and switchboard

Can be shown in operation

ENGINE GENERATORS

3 Phase 60 Cycle

625 KVA WESTINGHOUSE - AMES 4 cylinder vertical Uniflow, 150-175 lbs. 0-5 lbs. back pressure, 2300/600/480/240 volts.

500 KVA GENERAL ELECTRIC-AMES 4 cylinder vertical Uniflow, 150-175 lbs., 0-10 lbs. back pressure, 2300/600/480/240 volts.

438 KVA GENERAL ELECTRIC-SKINNER Uniflow, 150-175 lbs., 0-5 lbs. back pressure, 2300/600/480/240 volts.

210 KVA GENERAL ELECTRIC-AMES Uniflow, 125-150 lbs., 0-5 lbs. back pressure, 2300/600/480/240 volts.

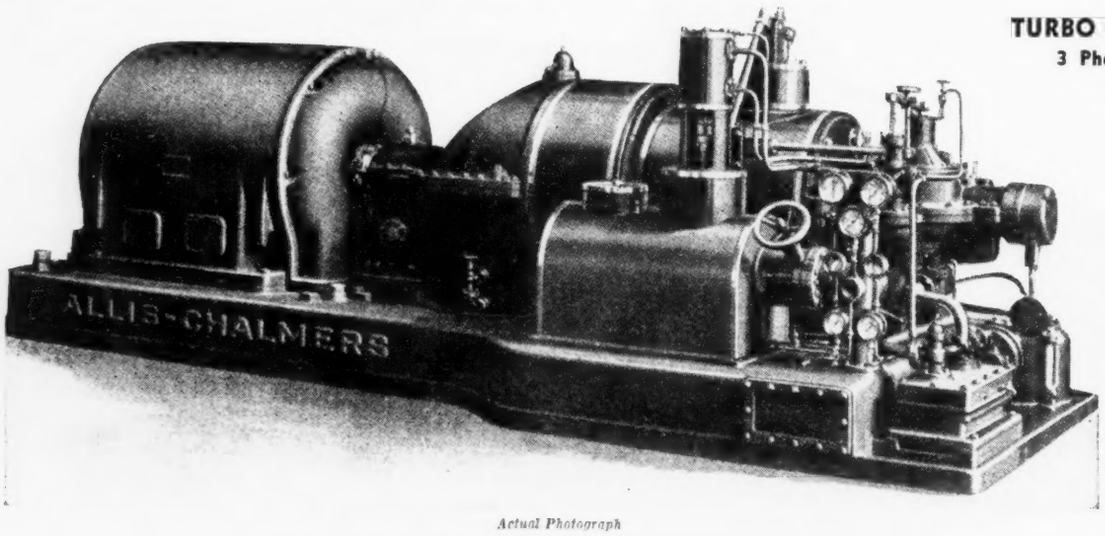
210 KVA (2) GENERAL ELECTRIC - SKINNER Uniflow, 125-150 lbs., 0-5 lbs. back pressure, 2300/600/480/240 volts.

ENGINE GENERATORS

125/250 Volts 3-Wire D.C.

150 KW CROCKER WHEELER-AMES 3 cylinder vertical uniflow, 250 lbs. 0.8 lbs. back pressure.

125 KW CROCKER WHEELER-AMES 3 cylinder vertical uniflow, 250 lbs. 0.8 lbs. back pressure.



Actual Photograph

1000 KW ALLIS CHALMERS CONDENSING TURBO UNIT

1000 KW 80% P.F. 1250 KVA Allis Chalmers alternating current generator 3 phase 60 cycle 2300 volts 3600 RPM direct connected to 1000 KW Allis Chalmers condensing turbine 150-200 lbs. steam pressure 100 deg. superheat. Equipped with jet condenser and auxiliaries.

TURBO GENERATORS

3 Phase 60 Cycle

9375 KVA GENERAL ELECTRIC condensing, 175-200 lbs. with surface condenser; 6600 volts.

5000 KVA GENERAL ELECTRIC condensing, 150 lbs., with surface condenser; 6600 volts.

2500 KVA WESTINGHOUSE condensing 150-200 lbs., 500 deg. TT, with jet condenser; 2300 volts.

1250 KVA ALLIS CHALMERS condensing 150-200 lbs., 500 deg. TT, with jet condenser; 2300 volts.

THE NATIONAL POWER

ER EQUIPMENT

ROTARY CONVERTERS

60 Cycle

3500 KW (2) WESTINGHOUSE, 225-285 volts D.C., 225 RPM with 3 phase 60 cycle 13200 volt transformers.

2500 KW WESTINGHOUSE, 600 volts D.C., 400 RPM with 3 phase 60 cycle 11000 volt transformer.

1500 KW WESTINGHOUSE, 225-285 volts D.C., 450 RPM with 3 phase 60 cycle 2300/4000-6900/12000 volt transformers.

1500 KW (2) WESTINGHOUSE, 600 volts D.C., 720 RPM with 3 phase 60 cycle 33000 volt transformers.

1000 KW (2) WESTINGHOUSE, 600 volts D.C., 900 RPM with 3 phase 60 cycle 12000 volt transformers.

750 KW GENERAL ELECTRIC, 600 volts D.C., 1200 RPM with 3 phase 60 cycle 2300 volt transformers.

500 KW (2) GENERAL ELECTRIC, 600 volts D.C., 1200 RPM with 3 phase 60 cycle 13200 volt transformers.

300 KW WESTINGHOUSE, 250 volts D.C., 600 RPM with 3 phase 60 cycle 2300 volt transformers.

ROTARY CONVERTERS

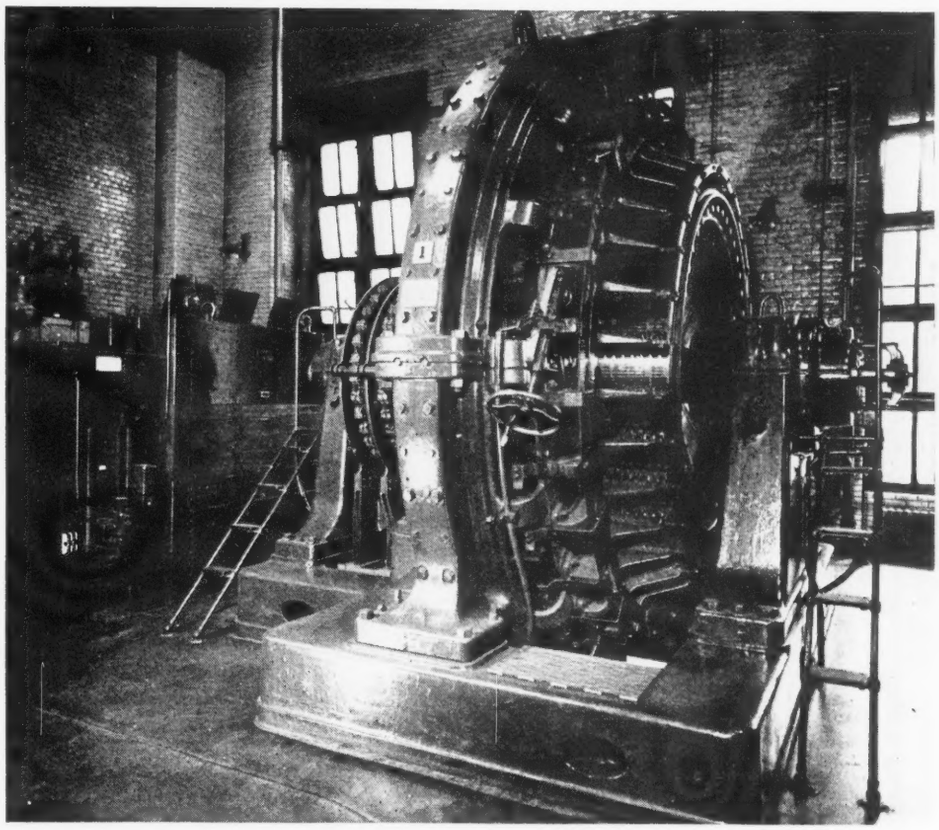
25 Cycle

2000 KW WESTINGHOUSE, 250-300 volts D.C., 300 RPM with 3 phase 25 cycle transformer any voltage.

1500 KW (2) GENERAL ELECTRIC, 600 volts D.C., 300 RPM with 3 phase 25 cycle 11000 volt transformers.

1500 KW (3) WESTINGHOUSE, 600 volts D.C., 250 RPM with 3 phase 25 cycle 6600 volt transformers.

1000 KW GENERAL ELECTRIC, 250 volts D.C., 214 RPM with 3 phase 25 cycle 6600 volt transformer.



Actual Photograph

3500 KW WESTINGHOUSE ROTARY CONVERTER

3500 KW (2) Westinghouse booster type interpole rotary converters, 225-285 volts D.C. 225 RPM; 6 phase 60 cycle A.C. with 3 phase 60 cycle 13200 volt transformers. Complete with control.

Can be shown in operation

MOTOR GENERATOR SETS

3 Phase 60 Cycle

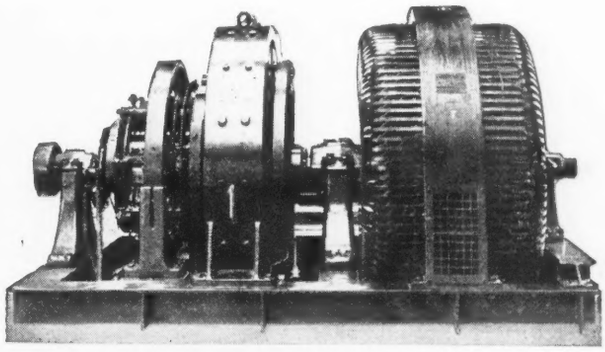
1000 KW GENERAL ELECTRIC synchronous, 125-250 volts 3-wire D.C.; 3 phase 60 cycle 13200 volts A.C., 720 RPM.

1000 KW GENERAL ELECTRIC synchronous, 275 volts D.C., 3 phase 60 cycle 6600 volts A.C., 514 RPM.

750 KW GENERAL ELECTRIC synchronous, 600 volts D.C., 3 phase 60 cycle 4000 volts A.C., 720 RPM.

450 KW GENERAL ELECTRIC 3-unit synchronous, 125-250 volts D.C.; 3 phase 60 cycle 4000/2300 volts A.C., 720 RPM.

170 KW GENERAL ELECTRIC induction, 125 volts D.C., 3 phase 60 cycle 2200/600/440 volts A.C., 1200 RPM.



1000 KW GENERAL ELECTRIC MOTOR GENERATOR SET

1000 KW GENERAL ELECTRIC direct current generator, 125/250 volts, 3-wire, 720 RPM., direct connected to 1400 HP 80% P.F. General Electric synchronous motor, 3 phase 60 cycle 13200/6600 volts, 720 RPM. Equipped with D.C. breakers. Can be shown in operation.

R MACHINERY CO. 1921 SCRANTON RD. CLEVELAND, OHIO

ELECTRICAL EQUIPMENT
REBUILT AND GUARANTEED
Immediate Shipment

SLIP RING MOTORS
60 Cycle—3 Phase

Quantity	HP	Speed	Make	Type
3	100	1150	West.	CW-856A (2400 V)
1	100	870	A.C.	ANY
1	100	865	G.E.	MT-356
1	100	865	G.E.	MTC-5346
1	100	580	G.E.	IM-15 (2200 V)
2	125	1150	West.	CW-766A
2	125	430	G.E.	IM-16
2	150	1750	G.E.	MTP-549
1	150	1740	G.E.	IM-E13A (2200 V)
1	150	870	West.	CW-870C
1	150	695	A.C.	ANY
1	150	690	West.	CW-876C (2200 V)
*1	150	680	West.	CI-856C
1	150	580	G.E.	IM-15A (2200 V)
1	150	580	West.	CW-938
2	150	490	West.	CW-956A (2200 V)
4	150	385	G.E.	IM-17
1	175	505	West.	CW-1002
2	200	1760	G.E.	IM-E13B (2300/4100 V)
4	200	600	G.E.	IM-16
2	250	720	C.W.	127Q
2	250	600	F.M.	HV-H300C (B.B.)
1	250	600	West.	CW
7	250	585	G.E.	IM-17 (2200 V)
2	300	1175	West.	CW
1	300	870	A.C.	ANY
2	300	585	G.E.	IM-17A (2200 V)
1	300	514	West.	CW-1106
6	300	514	G.E.	IM-17A
2	400	875	G.E.	IM-E17
6	400	514	G.E.	MT-410
1	400	505	West.	CW
1	400	300	G.E.	IM (Mill)
1	450	1180	G.E.	IM-E17A (2200 V)
1	450	500	West.	CW-1214
1	450	505	G.E.	MT-412
1	500	580	West.	CW
1	500	505	A.C.	.....
1	500	435	G.E.	MT-412 (2200 V)
1	600	505	West.	CW-1314
2	700	393	G.E.	MT-432 (2200 V)

* These are Intermittently rated motors for crane or hoist duty.

SQUIRREL CAGE MOTORS
60 Cycle—3 Phase

Quantity	HP	Speed	Make	Type
2	40	870	G.E.	IK
1	40	690	West.	CS
1	40	600	G.E.	KT
1	50	3500	G.E.	KT-327
2	50	1165	G.E.	KT-336
3	50	900	Linc.	C-15
3	50	900	West.	CCL
1	50	575	G.E.	KT-352
12	75	865	G.E.	KT-352
3	75	720	G.E.	IK-14
7	75	900	G.E.	KT-552
7	75	900	G.E.	KT-352 (2200 V)
1	75	1800	A.C.	AN
1	75	1170	West.	CS
3	100	1750	G.E.	IK-E13 (2200 V)
6	100	870	West.	CS-754C
1	100	1175	West.	CS-856 (2200 V)
1	100	495	A.C.	AN
1	150	690	G.E.	IK-15 (2200 V)
1	150	514	Burke	EM-35
1	150	1730	G.E.	IK-E13A
1	150	580	West.	CS
1	200	1175	A.C.	AN
1	200	1175	G.E.	IK-E15 (2200 V)
8	200	580	G.E.	KT-566
1	200	585	West.	CS-956A
1	200	700	G.E.	IK-15A (2200 V)
1	200	500	Wag.	BMR
1	250	580	G.E.	IK-17
1	300	1170	G.E.	IK-15B
1	350	600	G.E.	IK-17B
4	400	1750	West.	CS (2200 V)
1	400	1180	G.E.	KT-565 (2200 V)

The items listed on this page are but a small part of our complete stock of rebuilt equipment. Please wire or write for further details.

SYNCHRONOUS MOTORS
60 Cycle—3 Phase

HP	PF	Speed	Make	Type
1-30	.95	1800	Wag.	F.W.
3-50	0.8	600	G.E.	TS
1-50	.81	729	Wag.	FW
55	1.0	1200	EM	.....
1-60	1.0	1200	West.	.....
2-75	0.8	1200	Wag.	FW
2-75	1.0	1800	G.E.	TS
75	1.0	900	G.E.	ATI
1-75	.96	450	G.E.	TS
1-93	1.0	900	EMM	.....
1-100	0.8	900	Wag.	FW
2-125	0.8	900	G.E.	TS
200	0.8	1200	A.C.	.....
2-225	1.0	300	G.E.	TS
225	0.8	257	G.E.	TS
250	1.0	257	West.	HR
1-250	1.0	720	G.E.	ATI
1-300	0.8	720	G.E.	ATI
1-600	1.0	720	CW	.....
760	1.0	450	West.	.....

230 VOLT D.C. ADJUSTABLE SPEED MOTORS

Quantity	HP	Speed	Make	Type
5	1½	450/1800	West.	SK-20
1	2	500/2000	West.	SK-33
5	3	500/2000	G.E.	RF-8
3	6	450/1800	G.E.	RF-9
6	7½	600/1800	G.E.	RA-30
4	7½	500/1500	West.	SK-70L
8	12½	500/1500	G.E.	RLC-116
1	15	600/1800	Reliance	T-131
1	15	300/1200	G.E.	RF-12
2	20	500/1500	West.	SK-110L
2	25	600/1800	West.	SK-130
2	45	550/1650	West.	SK-150
1	50	565/1500	West.	SK-160
1	50	400/1200	G.E.	RLC-205
3	50	400/1200	West.	SK-163
1	75	600/1800	G.E.	RF-16
3	75	575/1200	West.	SK-183
1	75	475/1200	West.	SK-180
4	80	400/1200	Reliance	T-1050
1	85	450/1100	West.	SK-180
7	100	400/1200	A.C.	.....
3	100	320/960	West.	SK-200
3	150	320/850	West.	SK-210
1	550	100/300	G.E.	MPC

230 VOLT D.C. CONSTANT SPEED MOTORS

Quantity	HP	Speed	Make	Type
11	20	750	West.	SK-110L
1	25	1750	West.	SK-80L
2	25	1150	G.E.	CD-93
14	25	825	West.	SK-120
1	30	1100	West.	SK-110L
4	30	750	G.E.	RC
1	40	1700	G.E.	RC-31
1	40	1150	Reliance	T-185
1	40	1100	G.E.	RC-32
1	50	1700	G.E.	LC
2	50	1170	F.M.	DZB
2	53	1450	West.	SK-120
1	60	1150	G.E.	CD-113
1	60	875	West.	SK-150
2	60	680	West.	SK-160
1	75	1100	West.	SK-150
3	75	850	West.	SK-160
1	85	720	West.	SK-170
3	100	1150	West.	SK-163
3	100	600	G.E.	RC-38
3	125	1700	G.E.	RC-35
1	150	1150	C.W.	CMC-65H
1	150	1450/1750	G.E.	RCP-36B
1	150	1100	G.E.	MPC
1	150	700	A.C.	.....
2	200	1150	G.E.	RC-38
1	250	1150	C.W.	CMC-101A
1	550	100	G.E.	MPC

230 VOLT D.C. CRANE AND MILL MOTORS

Quantity	HP	Speed	Make	Type
2	3	750	G.E.	CO-1803
1	10	925	G.E.	CO-1805
2	15	600	G.E.	CO-1807
3	17	700	G.E.	MD-103
2	25	625	G.E.	CO-1808
5	50	525	G.E.	CO-1830
3	50	700	G.E.	CO-1829
2	50	725	G.E.	CO-1810
1	60	470	West.	K-10
2	66	525	C.W.	SM-FW

125 VOLT MOTOR GENERATOR SETS
3 Phase—60 Cycle

1—50 KW, General Electric, 1200 R.P.M., type CD-13 Generator, type KT-547, 2300/4000 v. mtr.
3—75 KW, General Electric, 1200 R.P.M., type RC-36 generator, type IK-E13A motor.
1—100 KW, General Electric, 1200 R.P.M. type RC-17A generator, type ATI synchronous motor.
1—150 KW, Westinghouse, 1200 R.P.M., type SK-184 generator, type CS-873C motor.

250 V. MOTOR GENERATORS
3 Phase—60 Cycle

3—100 KW, Westinghouse, 900 R.P.M. type SK generator.
1—200 KW, Burke, 720 R.P.M.; 300 H.P., .8 P.F., 720 R.P.M. G. E. type ATI synchronous motor.
2—200 KW Westinghouse, 1200 R.P.M. type SK generator, Columbia motor.

FREQUENCY CHANGERS

2—Westinghouse: Motor 290 H.P., 3 Phase, 25 Cycle, 750 R.P.M. Generator 250 KVA, 3 Phase, 62.5 Cycle, 750 R.P.M.
1—General Electric Motor 350 H.P., 3 Phase, 25 Cycle, 750 R.P.M.; Generator 300 KVA, 3 Phase, 62.5 Cycle, 750 R.P.M.

ARC WELDERS

Lincoln, Una and Westinghouse.

A. C. GENERATORS

550 KW, 450 R.P.M., Westinghouse 3 Phase, 60 Cycle
350 KVA, Allis Chalmers, 600 R.P.M., 3 Phase, 60 Cycle.
150 KW, General Electric type ATB form P, 600 R.P.M., 3 Phase, 60 Cycle.

D. C. GENERATORS

KW	Volt	R.P.M.	Make	Type
1000	250	720	G.E.	MCF
500	380	600	G.E.	MPC
400	250	100	G.E.	MPC
(2)- 300	250	375	G.E.	MPC
200	250	720	Burke	.....
200	250	260	West.	.....
150	250	900	G.E.	DLC

SYNCHRONOUS CONDENSER

750 KW, Westinghouse, 514 R.P.M., 3 Phase, 60 Cycle.

PUMPS

7000 G.P.M. Worthington 16 inch, 30 ft. head, 725 R.P.M.
2100 G.P.M. Gould, 290 ft. head, 1760 R.P.M.
1500 G.P.M. Deloval, 144 ft. head, 1200 R.P.M.

HOISTS

6—single drum 50 H.P. Lombert.

BLOWERS

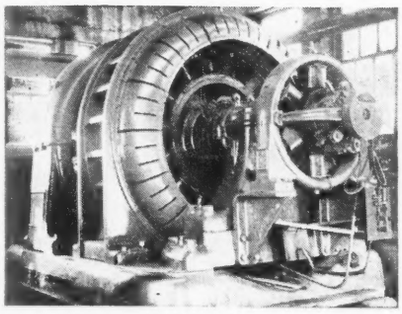
7,000 C.F.M., 20 inch American type PB.
10,000 C.F.M. 2½ inch Buffalo Forge.
(8) Green Fuel Economizer No. 3SA.

ELECTRIC GENERATOR & MOTOR CO.

4519 HAMILTON AVENUE, CLEVELAND, OHIO

AVOID DELAY...

Step up your Power



MOTOR GENERATOR SETS

1—500 KW, 650 volt, General Electric, syn.
1—300 KW, 250 volt, General Electric, syn.
1—100 KW, 125 volt, Westinghouse, syn.
1—75 KW, 250 volt, synchronous.
2—50 KW, 125 volt, Westinghouse, squirrel cage, with 4000 volt motors.
1—50 KW, 250 volt, General Electric, sq. cg.
1—50 KW, 125 volt, Westinghouse, sq. cg.
1—35 KW, 125 volt, El. Mach., sq. cg.
1—25 KW, 125 volt, General Electric, syn.
1—20 KW, 125 volt, Burke, squirrel cage

D. C. GENERATORS

1—100 KW, 750 RPM, 125 volt, West. Elec.
1—100 KW, 600 RPM, 125/250 volt, G.E.
1—75 KW, 260 RPM, 250 volt, Westinghouse.
1—67½ KW, 700 RPM, 45 volt, Gen. Elec.
2—32 KW, 650 RPM, 125 volt, Westinghouse.

MOTORS—3 PHASE 60 CYCLE

1—720 HP, 360 RPM, 440 volt, G.E., syn.
1—500 HP, 450 RPM, 2200/4000 volt, G.E., slip ring.
1—400 HP, 514 RPM, 440 volt, Westg., sl. rg.
1—350 HP, 300 RPM, 440 volt, G.E., slip ring.
1—350 HP, 100 RPM, 220/440 volt, G.E. syn.
1—335 HP, 600 RPM, 2300 volt, G.E., syn.
1—250 HP, 450 RPM, 220 volt, G.E., slip ring.
1—250 HP, 360 RPM, 440 volt, Westg. sq. cg.
1—250 HP, 514 RPM, 4000 volt., G.E., syn.
1—200 HP, 900 RPM, 440 volt, Westg., sl. rg.
1—200 HP, 600 RPM, 2200 volt, G. E., sl. rg.
1—200 HP, 450 RPM, 2200/4000 v., G.E., sl. rg.
1—200 HP, 514 RPM, 4000 volt, G.E., syn.
1—175 HP, 900 RPM, 440 volt, Westg. syn.
1—150 HP, 1800 RPM, 2300 v., Allis Chal. sq. cg.
1—150 HP, 1200 RPM, 4150 volt, Ideal, syn.
1—150 HP, 900 RPM, 440 volt, Allis Chal. sl. rg.
2—150 HP, 720 RPM, 220 v., Elec. Mach. syn.
1—150 HP, 720 RPM, 440 volt, G.E., slip ring.
1—150 HP, 720 RPM, 2200 volt, G.E., sq. cg.
1—150 HP, 400 RPM, 440 volt, G.E., sq. cg.
2—125 HP, 720 RPM, 440 volt, G.E., slip ring.
2—125 HP, 450 RPM, 440 volt, G.E., syn.
1—100 HP, 1800 RPM, 440 v., Allis Chal. sq. cg.
1—100 HP, 900 RPM, 220 volt, G.E., sq. cg.
1—100 HP, 900 RPM, 440 volt, G.E., slip ring.
1—100 HP, 720 RPM, 440 volt, G.E., slip ring.
1—100 HP, 720 RPM, 440 volt, G.E., sq. cg.
1—100 HP, 600 RPM, 440 volt, G.E., slip ring.
1—100 HP, 600 RPM, 440 volt, G.E., sq. cg.

MOTORS—3 PHASE 60 CYCLE—(Continued)

1—100 HP, 514 RPM, 440 volt, G.E., sq. cg.
2—100 HP, 450 RPM, 440 volt, G. E., sq. cg.
1—75 HP, 1800 RPM, 220/440 v., G. E., sq. cg.
1—75 HP, 900 RPM, 4000 v., Elec. Mach. syn.
1—75 HP, 900 RPM, 440 volt, G.E., enclosed, fan cooled, squirrel cage.
1—75 HP, 900 RPM, 220 volt, Fairbanks-Morse, slip ring.
1—75 HP, 900 RPM, 2200 volt, G.E., slip ring.
1—75 HP, 514 RPM, 440 volt, G.E., sq. cg.

MOTORS—D. C. 230 VOLTS

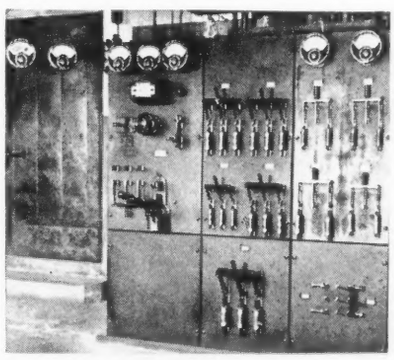
1—125 HP, 850 RPM, G.E., type CD.
1—125 HP, 550 RPM, General Electric.
1—100 HP, 1600 RPM, Westg., type SK.
1—75 HP, 850 RPM, Westinghouse, type SK.
1—65 HP, 1000 RPM, G. E., type RC.
1—50 HP, 1750 RPM, Westinghouse, type SK.
1—50 HP, 1100 RPM, Crocker Wheeler.
1—50 HP, 700 RPM, Crocker Wheeler.
1—40 HP, 1100 RPM, G.E. type RC.
1—40 HP, 300 RPM, General Electric.
1—30 HP, 750 RPM, G.E., type RC.
1—30 HP, 725 RPM, Westinghouse, type SK.

OIL CIRCUIT BREAKERS

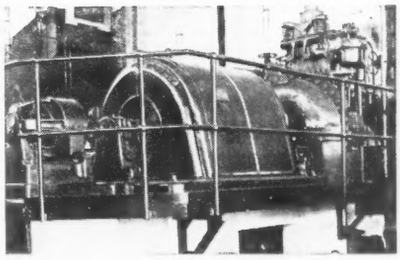
2—3000 amp., 15,000 v., 3 pole, G.E., type FK-130.
1—3000 amp., 600 v., 4 pole, G.E., type FK-24.
2—2000 amp., 15,000 v., 3 pole, G.E., type FK-53b.
1—1600 amp., 7500 v., 4 pole, Westg., B-2.
1—1500 amp., 440 v., 3 pole, Condit, D12.
1—1200 amp., 15000 v., 4 pole, Westg., B-2.
Also complete stock of small sizes.

ALTERNATORS

1—625 KVA, 450 RPM, 600 volt, Westg.
1—625 KVA, 3600 RPM, 600 volt, G.E.
1—400 KVA, 400 RPM, 240 volt, Westg.
1—375 KVA, 240 RPM, 2300 volt, Westg.
1—375 KVA, 200 RPM, 240 volt, Elec. Mach.
1—250 KVA, 720 RPM, 230 volt, G.E.
1—200 KVA, 3600 RPM, 240 volt, Allis Chal.
1—100 KVA, 1200 RPM, 440 volt, G.E.
1—37½ KVA, 1200 RPM, 2400 volt, Westg.
1—15 KVA, 1800 RPM, 120 volts, G.E.



Switchboard Panel built by us for Synchronous Motor Generator Set



TRANSFORMERS

1—15,000 KVA, Pitts., 3 ph., 26,000/4150 v.
4—833 KVA, Allis Chal., 25 cy., 13,200/440 v.
3—400 KVA, Moloney, 13,800-220/440 volts.
2—400 KVA, G.E., 4156-240/480 v., Scott taps.
3—300 KVA, Pittsburgh, 7800/440 volts.
3—300 KVA, Pittsburgh, 4600-115/230 volts.
4—200 KVA, Pittsburgh, 7800-110/220 volts.
3—150 KVA, G.E., 33,000-2300/4000 Y.
3—150 KVA, Pittsburgh, 6600/440 volts.
12—150 KVA, G.E., 3 ph., 4150-120/208 v.
1—150 KVA, Westg., 440-220/110 v.
3—125 KVA, General Electric, 2300/480.
3—100 KVA, Westinghouse,13200-250 volts.
3—100 KVA, G.E., 2400-240/480 volts.
3—100 KVA, Wagner, 2300-240/120 volts.
1—75 KVA, Pittsburgh, 7600-110/220 volts.
3—75 KVA, Pittsburgh 2200-115 volts.
3—50 KVA, Wagner, 4150-220 volts.
4—50 KVA, Westg., air cooled, 440-220/220-110 v.
3—50 KVA, Westinghouse, 220-110/220 volts.
3—50 KVA, G. E., 2200-110/220 volts.
52—37½ KVA, 2200-220-110 v.
10—25 KVA, Westg., air cooled, 440/220-110 v.
3—25 KVA, Moloney, 2200-220/110 volts.
1—25 KVA, G.E., 220/110-220/110 volts.
2—15 KVA, G.E., 2300-115/230 volts.
1—15 KVA, GE., 440/110-220 volts.
12—15 KVA, Westg., air cooled, 440/220-220-110 v.
4—10 KVA, G. E., 2300-115/230 volts.
3—7½ KVA, G.E., 440-110/220 volts.

TURBO-GENERATORS

2—1000 KW, 3 ph., 60 cy., 2300/4150 v., cond.
1—500 KW, G.E., 3 ph., 60 cy., 480 volt, bleeder.
1—400 KW, General Electric, non-condensing.
1—300 KW, G.E., 3 ph., 60 cy., 220 v, cond.
1—200 KW, G.E., 3 ph., 60 cy., 220 volt, cond.
1—150 KW, 125/250 volt, Westg., non-cond.
1—100 KW, 125 volt, Westg., non-cond.
1—35 KW, 125 volt, G.E., non-cond.
1—25 KW, 125 volt, Ridgeway, non cond.

MOTORS—VARIABLE SPEED 230 VOLTS

1—90 HP, 470/940 RPM, General Electric.
1—75 HP, 235/950 RPM, Burke.
1—60 HP, 600/1200 RPM, General Electric.
1—30 HP, 225/900 RPM, Crocker Wheeler.
1—25 HP, 400/1200 RPM, Westinghouse.
1—20 HP, 750/1500 RPM, General Electric.
1—5 HP, 600/1200 RPM, General Electric.
6—5 HP, 400/1200 RPM, Westinghouse.
1—5 HP, 225/900 RPM, Electro Dynamic.
1—5 HP, 600/1800 RPM, General Electric.
1—3 HP, 500/2000 RPM, Westinghouse.

J. L. HEMPHILL & CO., INC., Power Equipment

New York Phone: LOngacre 5-3227 — 1602 53rd ST., NORTH BERGEN, N. J. — New Jersey Phone: PAlisade 6-2600

THE PICK OF POWER EQUIPMENT

TURBO UNITS—60 Cy.
1—12500 KVA Westinghouse Cond.
1— 9375 KVA General Electric Cond.
1— 7500 KVA General Electric Cond.
1— 6250 KVA General Electric Cond.
1— 5000 KVA Allis Chalmers Cond.
1— 3750 KVA Westinghouse Cond.
1— 3125 KVA Allis Chalmers Cond.
2— 2500 KVA Westinghouse Cond.
1— 2500 KVA General Electric Cond.
1— 1563 KVA General Electric Cond.
1— 1250 KVA General Electric Cond.
1— 937 KVA General Electric Cond.
1— 750 KVA Terry Double Extraction
3— 625 KVA General Electric Cond.
1— 625 KVA General Electric Extr.
1— 375 KVA General Electric Cond.
1— 250 KVA General Electric Cond.
1— 375 KVA General Electric Non-C.
1— 312 KVA Moore Non-Condensing
2— 156 KVA Allis Chalmers Non-C.
1— 125 KVA Westinghouse Non-C.

STEAM ENGINE UNITS—60 Cy.
1—1067 KVA Nordberg Uniflow
1—1000 KVA Skinner Uniflow
2— 937 KVA Nordberg Uniflow
1— 500 KVA Skinner Uniflow
1— 500 KVA Rice & Sargent Corliss
1— 425 KVA Hamilton Poppet Valve
1— 325 KVA Skinner Uniflow
1— 250 KVA Skinner Uniflow
1— 240 KVA Hamilton Corliss

DC STEAM ENGINE UNITS
1—500 KW Skinner Uniflow 250 V.
1—400 KW Mesta Uniflow 250 V.
1—300 KW Skinner Uniflow 250 V.
1—300 KW Chuse 4-valve 250 V.
2—250 KW Skinner Uniflow 250 V.
1—200 KW Chuse 4-valve 250 V.
2—150 KW Erie Ball 4-valve 250 V.
1—150 KW Ames Uniflow 125/250 V. 3-wire
1—125 KW Ames Uniflow 125/250 V. 3-wire
1— 75 KW Skinner Uniflow 250 V.
1— 50 KW Ames Uniflow 125/250 V. 3 wire

OIL & GAS ENGINE UNITS—60 Cy.
1—1750 KVA Mesta (gas) 2300 V.
2—1000 KVA Mesta (gas) 2300 V.
1—1000 KVA Nelseco Diesel 2300 V.
1— 603 KVA Fair.-Morse 480 V.
1— 375 KVA Cooper-Bess. 2300 V.
1— 375 KVA Ing.-Rand—2300/440/220 V.
1— 237 KVA Fair.-Morse 480 V.
1— 210 KVA Natl. Superior 440/220 V.
1— 200 KVA Fair.-Morse 2400/440/220 V.
1— 100 KVA Buckeye 240/480 V.

WATER TUBE BOILERS
2—750 HP Badenhausen 200-lb. Stokers
5—525 HP Springfield 200-lb. Stokers
2—520 HP Heine 200-lb. Hand Fired
2—511 HP Union 200-lb. Stokers
2—500 HP Heine 200-lb.
1—484 HP Springfield 225-lb. Stoker
1—468 HP Keeler type C-P 250-lb.
2—407 HP Erie City 250-lb. Stokers
2—389 HP Stirling 200-lb. Stokers
1—375 HP B. & W. 200-lb. Stoker
2—357 HP Casey-Hedges 175-lb. Stokers
1—353 HP Edge Moor 200-lb.
1—325 HP Stirling 160-lb. Stoker
2—282 HP Edge Moor 200-lb. Stokers
2—254 HP Stirling 180-lb. Stokers
2—160 HP Stirling 155-lb. Hand Fired

SYNCHRONOUS CONDENSERS
1—4000 KVA G. E. 13200 V. 514 RPM
1—2000 KVA G. E. 11000/2200 V. 720 RPM
1—2000 KVA C. W. 11000 V. 600 RPM
1—1000 KVA G. E. 2300 V. 900 RPM
1— 500 KVA West. 2200 V. 900 RPM

1 PHASE INDUCTION REGULATORS
2— 94 A. 13800 V. G. E. 10% reg.
6—100 A. 2400 V. G. E. 10% reg. outdoor
10—150 A. 2400 V. G. E. 10% reg. outdoor
1—200 A. 2400 V. G. E. 10% reg. outdoor
1—300 A. 2400 V. G. E. 10% reg. outdoor

OIL CIRCUIT BREAKERS
1—800 A. 87 KV Am. Br. Bov. AF22 Outdr.
2—600 A. 37 KV Condit F040-37 Outdoor
5—600 A. 30 KV Kelman CB-76 Outdoor
1—400 A. 25 KV G. E. FK0136 Outdoor

FREQUENCY CHANGERS
2—3125 KVA West. 25/62½ cy. 750 RPM
1—3000 KVA West. 60/25 cy. 300 RPM
1—2500 KVA West. 25/60 cy. 300 RPM
1—1250 KVA G. E. 25/62½ cy. 375 RPM
1—1000 KVA G. E. 60/25 cy. 514 RPM
2— 750 KVA G. E. 25/60 cy. 300 RPM
1— 500 KVA G. E. 25/60 cy. 300 RPM

ROTARY CONVERTERS—60 Cy.
2—1000 KW General Electric, 600 V.
1— 750 KW General Electric, 250 V.
1— 500 KW General Electric, 250 V.
1— 500 KW General Electric, 600 V.
2— 300 KW General Electric, 600 V.

TRANSFORMERS—1 Ph. 60 Cy.
3— 600 KVA West. 120,000/2300 V.
3— 1667 KVA G. E. 66000/22000 V.
1— 1500 KVA Pitts. 66000/33000 V. 3 ph.
3— 750 KVA Pitts. 66000-22000/33000 V.
3— 333 KVA Pitts. 44000/2300 V.
3— 500 KVA Allis 33000/480 V.
3— 400 KVA West. 33000/6900 V.
2— 1000 KVA G. E. 23000-11500/575 V.
3— 100 KVA G. E. 22000/6900 V.
2—1000 KVA Pitts. 13200/4600 V. 3 ph.
1— 450 KVA G. E. 13200/240-480 V. 3 ph.
3— 200 KVA West. 13200/2300-4000 V.
3— 150 KVA Pitts. 13800/230-460 V.
3— 75 KVA West. 13800/230-460 V.
3— 150 KVA Pitts. 11000/2400 V.
3— 100 KVA West. 11000/250-125 V.
3—75 KVA G. E. 11,000-9900/244-488 V.
2— 3300 KVA G. E. 6600/110 V. 3 ph. Furnace
3— 1250 KVA G. E. 6600/550 V.
3— 100 KVA G. E. 6900/440-220 V.
3— 833 KVA Penn. 4800/120-240 V.
3— 1500 KVA West. 2300/106 V. 3 ph. Furnace
3— 100 KVA Pitts. 2300-4600/550 V.
3— 75 KVA Wagner 2300/230-460 V.
6— 50 KVA G. E. 2400/240-120 V.
3— 50 KVA Wagner 2400/480 V.

PARTIAL LIST—WE HAVE ALL CLASSES OF POWER EQUIPMENT

BREW, WOLTMAN & Co., INC.

50 CHURCH STREET, NEW YORK CITY

Get what you want IN A HURRY

from L. J. LAND & COMPANY, New York's Largest Stock of Electrical Equipment

A.C. EQUIPMENT

SYNCH. MOTORS
200 H.P. G.E. TS 514 RPM
90 H.P. Westinghouse 900 RPM
50 H.P. Elec. Mchy. 1200 RPM

SLIPRING MOTORS
300 H.P. General Electric 720 RPM
200 H.P. General Electric 514 RPM
150 H.P. Allis Chalmers 720 RPM
112 H.P. G.E. hoist 720 RPM
100 H.P. Fairbanks Morse 720 RPM
100 H.P. Allis Chalmers 720 RPM
100 H.P. Westinghouse 720 RPM
75 H.P. Westinghouse 1200 RPM
75 H.P. Allis Chalmers 600 RPM
60 H.P. Westinghouse 1200 RPM
60 H.P. General Electric 1200 RPM
60 H.P. General Electric 900 RPM
60 H.P. Westinghouse 300 RPM
40 H.P. GE. MT 900 RPM

SQUIRREL CAGE MOTORS
200 H.P. Allis Chalmers 1800 RPM
200 H.P. Allis Chalmers 1200 RPM
200 H.P. General Electric 600 RPM
150 H.P. Westinghousee 1800 RPM
125 H.P. Allis Chalmers 1200 RPM
100 H.P. G.E. 1200 RPM
100 H.P. General Electric 900 RPM
75 H.P. Westinghouse 900 RPM

A.C. GENERATORS
200 K.W General Electric 600 RPM
100 KVA Crocker Wheeler 900 RPM
100 KVA Elec. Machy. 1200 RPM
75 KVA G.E. 1200 RPM
15, 20, & 25 KVA 1200 RPM (8)

LOW & HIGH VOLT. GEN.
200 K.W. Wghse. 600 V. Mtr. Gen Set
800 amp. 10-50 Volts G.E.
2 to 40 K.W. 600 to 2000 V. M.G. Sets (11)
24 K.W. 60 V. General Electric
1 to 75 K.W. 10 to 80 V. (45)

100 KW Westinghouse Syn.
MOTOR GENERATOR SET
Motor: 150 H.P. 3 ph. 60 cycle 440 V 1200 RPM
Gen. 100 KW 250 Volt 1200 RPM—Complete AC & DC Control Equipment

ANODIC TREATING GENERATORS
3—1600 Amp. General Electric, Syn. 3 unit Motor Generator Sets, 10 to 50 Volts—complete.

In Stock for Immediate delivery
Motor Driven Electric ARC Welders—Portable and Stationary—150 Amp. to 600 Amp.

MISCELLANEOUS
12½ x 12, 390' Amer. Air Comp.
14 x 10 Ingersoll Rand Air Comp.
1 Ton Shepard
75 to 50 K.W. Frequency Changers 90, 100, 120 cycle (7)
5 H.P. B & D D.C. Buffer Fans & Blowers (19)
Tirrell Voltage Regulators
6—200 KVA G.E. Transformers 13200/2300/4000
165 KVA Arc Furnace Transformers

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New York City's Largest Stock Electrical Equipment
ONE YEAR GUARANTEE

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Reading, Penna. Office: 12th and Spring St.
Over Quarter Century Serving Industry

D.C. EQUIPMENT

230 V. D.C. MOTOR GEN. SETS
100 K.W. West. 1200 RPM
75 K.W. Elect. Machy. 1200 RPM
50 K.W. Burke 1200 RPM
45 K.W. Westinghouse 700 RPM

125 V. M.G. SETS
100 K.W. Gen. Elec.
60 K.W. Westinghouse Syn. mtr.
50 K.W. Crocker Wheeler
40 K.W. Westinghouse
35 K.W. Elec. Machy. Synch.
25 K.W. Gen. Elec.

230 V. D.C. MOTORS
75 H.P. General Electric 850 RPM
60 H.P. Sprague 900 RPM
60 H.P. G.E. 1000 RPM
60 H.P. Roth 600 RPM
50 H.P. G.E. 850 RPM
40 H.P. Reliance 625 RPM

230 V. VAR. SPEED MTR.
100 H.P. Crock. Wh. 550/900 RPM
75 H.P. Electro Dyn. 700/1050 RPM
75 H.P. G.E. 1800/1500 RPM
50 H.P. Gen. Elec. 500/1500 RPM
30 H.P. G.E. 825/2000 RPM
25 H.P. G.E. CD 600/1200 RPM
15 H.P. G.E. RF 400/1200 RPM
15 H.P. West .825/1650 RPM
15 H.P. G.E. 600/1800 RPM
15 H.P. Electro Dyn. 450/1350 RPM

115 VOLT D.C. MOTORS
90 H.P. General Electric 900 RPM
30 H.P. Star B.B. 1800 RPM
15 H.P. Eck 1500/1800 RPM

SUCCESSFUL OPERATION GUARANTEED

Every Machine in This Ad is Owned Outright By Us

D C MOTORS

230 Volt—Constant Speed

	HP	Make	Type	Speed
1—	300	Cr.Wh.	CCM-108H	550
1—	250	Al.Ch.		525
2—	200	Whse.	SK	400
1—	200	G.E.	DMC	475
1—	150	G.E.	MPC	275
1—	140	G.E.	MDS-108	410
1—	125	G.E.	CDP-123	1750
1—	100	G.E.	CD-123	1150
1—	75	Cr.Wh.	CMC-65H	600
1—	45	Cr.Wh.	65H	400
1—	30	Whse.	SK	850

D C GENERATORS

	KW	Make	Type	Volts	Speed
1—	1000	Whse.	Engine	500	300
1—	500	Whse.	Engine	250	167
2—	500	G.E.	MPC	600	720
1—	300	G.E.	MPC	550	720
1—	250	Cr.Wh.	CCD	250	600
1—	200	G.E.	ETF	125	1800
1—	200	Al.Ch.		250	580
2—	175	Whse.	SK	250	450
1—	150	Whse.	Engine	550	750
1—	75	Ridg.		250	2000
1—	60	Whse.	SK	125	1150

MOTOR GENERATOR SETS

3 phase—25 cycle

1—2000 KW Al. Ch. 250 v. Gen d.c. to 2800 HP 6600 v. syn. motor
1—300 KW G.E. 600 v. Gen d.c. to 435 HP 2300 v. syn. motor
1—250 KW G.E. 275 v. Gen d.c. to 390 HP 6600 v. syn. motor

MOTOR GENERATOR SETS

3 phase—60 cycles

2—1500 KW G.E. 600 v. Gen d.c. to 2100 HP 6600 v. syn. motor
2—1000 KW G.E. 250 v. Gen d.c. to 1400 HP 11000 v. syn. motor
1—500 KW G.E. 600 v. Gen d.c. to 700 HP 13200 v. syn. motor
1—500 KW G.E. 600 v. Gen d.c. to 700 HP 2300 v. syn. motor
1—400 KW G.E. 275 v. Gen d.c. to 600 HP 2300 v. syn. motor
2—300 KW G.E. 600 v. Gen d.c. to 435 HP 10000 v. syn. motor
1—250 KW G.E. 275 v. Gen d.c. to 350 HP 4600 v. syn. motor
1—200 KW Ridg. 275 v. Gen d.c. to 300 HP 2300 v. syn. motor
2—200 KW Al. Ch. 3 units; 2—100 KW 250 v., Gen. d.c. to 220 KVA 2200 v. Syn. motor
1—150 KW Ridg. 275 v. Gen d.c. to 230 HP 2300 v. syn. motor
1—125 KW G.E. 250 v. Gen d.c. to 190 HP 2200 v. syn. motor
1—100 KW Whse. 125 v. Gen d.c. to 150 HP 440 v. sq. cg

ADJUSTABLE SPEED

1—	600	Whse.		150/275
1—	300	G.E.	MPC	250/400
2—	275	G.E.	DMC	500/750
1—	200	Whse.		400/500
1—	150	G.E.	MPC	250/450
2—	100	G.E.	CD-123	1150/1450
1—	75	Cr.Wh.	65H	600/1200
1—	75	G.E.	C	500/1000
2—	60	El.Dy.	S	525/1050
1—	50	Whse.	SK	350/1050
1—	50	Rel.	461T	500/1500
1—	30	Whse.	SK	575/1150
1—	25	Cr.Wh.	50H	335/1000
2—	15	Whse.	SK	825/1650
1—	14	El.Dy.	10S	300/1200

SYN. CONDENSER

1—4000 KVA G.E. 2 unit 3 brg. condenser set with exciter, consisting of
Cond. 4000 KVA ATI 514 RPM 13200 v. 3 ph. 60 cy.
Motor 1150 HP ATI 514 RPM 13200 v. 3 ph. 60 cy.
Exciter 100 KW MPC 514 RPM 125 v. comp. wd.

TURBO GENERATOR SET

1—500 KW, Whse., 625 KVA, 480 v., 3 ph., 60 cy. generator with Curtis single stage 160/225 pound non-condensing turbine good for 5 to 10 pounds back pressure
1—500 KW, G.E., 625 KVA, 2300 v., 3 ph. 60 cy. generator with Curtis 4 stage, 150 pound condensing turbine complete with condenser, etc.

ROTARY CONVERTERS

1—300 KW. Al. Ch. Syn. D.C. 250 v., 1200 RPM. with 3—125 KVA transf. 4800/2400 v., 1 ph., 60 cy. and panels.
1—500 KW. G.E. type HCC, 1200 RPM., D.C., 600, V, AC. 6 ph, 60 Cy., 1200 RPM.

TRANSFORMERS

	KVA	Make	Ph.	Type	Voltages
1—	1250	Whse.	3	Auto	4000x2300
4—	1000	G.E.	1	HKDD	13800x2300
3—	333	G.E.	1	HKDD	2300x460
3—	333	Pitts.	1	OISC	13800x440/220
3—	300	G.E.	1	H	132200x2300/575
2—	200	Whse.	1	SK	6900x230/460
3—	200	G.E.	1	HKDD	13800x575
3—	100	Whse.	1	OISC	13200x250
3—	100	G.E.	1	H-KS	2300x230/460
6—	75	G.E.	1	H-KF	2300x230/460
3—	75	Moloney	1	HE	440x110/220

ENGINE GENERATOR SET

1—100 KW. Whse. D. C. Gen. 125/250 v. 3 wire 250 R.P.M. dir. Conn. 150 H.P., 14x15 Skinner steam engine 150# press.

OIL CIRCUIT BREAKERS

1—5000 amp., 600 v., 3 PST GE FK-25 solenoid operated (125 v. DC) all mounted on floor stand frame with tank lifter
1—4000 amp. 600 v. 3 PST GE FK-25 otherwise same as above
1—3000 amp. 600 v. 3 PST GE FK-25 otherwise same as above

A C MOTORS

3 phase—60 cycle

Synchronous

	HP	Make	Type	Volts	Speed
1—	2150	G.E.	ATI	2200	360
1—	2000	G.E.	ATI	2300	450
1—	350	Cr.Wh.	301	2200	600
1—	300	G.E.	ATI	440	600
1—	300	G.E.	ATI	2300	600
1—	200	Whse.		440	514
3—	150	G.E.	TRB	220x440	450
1—	150	Whse.		2200/550	1800
1—	100	Whse.		2200/550	1800
1—	100	Whse.	HP	220	300
1—	100	Whse.	G	2300	900
1—	75	Whse.		440/220	900

Slip Ring

1—	1000	G.E.	IM	2200	720
1—	800	Whse.	Mill	2200	250
1—	600	Whse.	CW	2200	870
1—	450	Whse.	CW	2200	875
1—	450	G.E.	MTP	2200	1200
1—	400	G.E.	MT	550/440	300
1—	400	Al.Ch.		2300	505
1—	300	Al.Ch.	ANY	2200	585
1—	300	Whse.	CW	2300	1170
2—	300	G.E.	IM	2300	585
1—	250	G.E.	MT	4000/2300	257
1—	250	F.M.	BV	2200	1200
2—	200	Whse.	CW	2200	514
2—	150	G.E.	IM	2200	695
1—	100	G.E.	IM	550	720

Squirrel Cage

1—	500	G.E.	I-17B	2200	690
1—	400	G.E.	KT	2300	585
1—	300	Whse.	CS	550	580
2—	300	G.E.	IK	2300	600
2—	300	G.E.	IK	440	600
1—	250	Al.Ch.		220/440	1150
1—	200	Whse.	CS	550	720
1—	150	G.E.	IK	2200/440	900
3—	150	Al.Ch.	AN	220/440	1750
3—	100	Whse.	CS	550	1800
1—	75	G.E.	KT	220/440	514
2—	50	Whse.	CS	440	1750
2—	40	Whse.	CS	440/220	870

RE-NU-BILT SIGNIFIES RELIABILITY

RE-NU-BILT BELYEA MOTORS

What are your requirements? units up to 5000 kw available in stock.

BELYEA COMPANY INC.

Main Office & Shop: 43 HOWELL ST., JERSEY CITY, N. J.

MOTORS • GENERATORS • TRANSFORMERS

Prices on application

3 PHASE—60 CYCLE 220/400 VOLT

H.P.	Make	RPM	Type	Frame
15	Allis-Chalm.	1750	2K54411	
20	Gen. Elec.	1750	KT	753
20	Gen. Elec.	600	I	K
25	Burke	900	EM	
40	Gen. Elec.	900	KT	336
40	Burke	1200	EM	45
40	Westing.	1750	CS	
50	Westing.	900	CS	
50	Gen. Elec.	900	KT	542
60	Burke	900	EM	7
60	Gen. Elec.	1200	I	K
60	Gen. Elec.	1800	I	K
75	Gen. Elec.	1200	KT	343
5) 75	Gen. Elec.	1200	I	K
75	Gen. Elec.	1800	I	K
75	Gen. Elec.	900	I	K
100	Burke	720	EM	10
100	Gen. Elec.	1750	I	K
100	Westing.	900	CS	
100	Lincoln	1200		
150	Gen. Elec.	1200	I	
150	Westing.	900	CS	
200	Gen. Elec.	600	I	K
200	Gen. Elec.	720	I	K
200	Gen. Elec.	900	I	K
200	Gen. Elec.	1200	I	K
250	Gen. Elec.	600	I	K
250	Gen. Elec.	720	I	K
250	Allis-Chalm.	900		
300	Gen. Elec.	720	I	K

Compensators in stock up to 300 H.P.

100 K.V.A. GENERATOR For Diesel Use

1—100 KVA Crocker Wheeler 3/220/60 cy. 257 RPM. For direct connection to Diesel. 2 Bearing Machine with exciter and panels.

ANODIZING M. G. SET

1—1000 Amp. 60 Volt General Electric Generator, Type CD-115Y, 1200 RPM, direct connected to 90 H.P. General Electric Synchronous Motor, 3 phase, 60 cycle, 440 volt, 1200 RPM; 3-bearing Factory built machine, complete.

FREQUENCY CHANGERS

1—600 KW Gen. Elec. Syn. 2300 V., 25 cy. to 2300 V. 60 cy.
1—565 KVA Westinghouse Synch. 2200 V. 25 cy. to 220 V. 3 Ph. 60 cy.
2—400 KW General Electric Synch. 6600 V., 25 cycle to 440/2300 V. 60 cy.
1—150KW Gen. Elect. Type A.T.B. 3/60/220 V. direct connected to 200 HP. 3/25/2200 V. Motor with direct connected exciter.
1—125 KW G.E. ITT-565, 62½ cy., 3 ph., 235 V., 750 RPM. Ser. No. 5207711; dir. con. to 100 HP G.E. KT559 25/3/220/440/750 RPM.
1—60 KW G. E. ITT-546, 125 cy. 3 ph., 90 amps., 470 V., 8 P.F., Ser. No. 5207709.

SPECIAL MOTORS

1100 H.P. General Electric Synchronous Motor, 3 ph., 25 cy., 11,500/6600/2200 V., 375 RPM.
1—500 H.P. Gen. Elect. Sync. 3/2200/60/1200 R.P.M. with Exciter. New.
500 H.P. Allis-Chalmers, 3 ph., 25 cy., 440 V., 490 R.P.M., Complete.
300 H.P. G.E. Slipring, 25 cy., 3 ph., 2200 V., 500 RPM, 3 bearing; complete with controls.
225 H.P. Electric Mchy. Co. Synchronous, 3 ph., 25 cy., 2200 V., 500 R.P.M. with controls.
2—100 H.P. G.E. Synch. Motors, 3 ph., 25 cy., 220/440 V., with control equipment.

BARGAIN

30—3 HP. General Electric Motors. 3/60/220/3600 rpm. $37.00 each.

TRANSFORMERS

Amt.	KVA	Make	Cycle	Voltage
3	40	Gen. Elec.	25	2200/440
3	50	Gen. Elec.	60	2200/220/440
2	75	West.	60	2200/120/240
3	100	Gen. Elec.	60	24/120/240
2	100	Gen. Elec.	60	4600/115/230
3	200	Gen. Elec.	25	13,200/240/480
3	333	Gen. Elec.	60	6900/230/460
3	500	Gen. Elec.	60	2200/220/440
3	500	Pittsburgh	25	11,500/100
3	1000	Pittsburgh	60	2300/4600/115
3	1000	KVA.Wagner	60	33000/2300

All Sizes and Voltages Available.

SLIPRING MOTORS

60 CYCLE, 3 PHASE, 220/440 VOLTS

H.P.	Make	Type	Frame	RPM
300	Gen. Elec.	I	M	1185
75	Gen. Elec.	MT	537	1800
60	Gen. Elec.	MT	353	1800
60	Gen. Elec.(2)	MT	353	720
50	West.	CW	654C	1800
50	West.	CW	644C	900
50	West.	CW	654C	1800
40	Wagner	22WB		540
40	West.	CW	748	690
40	West.	CW	748	690
40	West.	CW	748	690
30	West.	HF	8B	1745
30	Gen. Elec.	MTC		1725
25	Gen. Elec.	MT	513	1800
25	Gen. Elec.	I	M	1200
25	West.	CW	750C	575
20	West.	CW	648A	575
20	West.	CW	644C	575
20	Gen. Elec.	MT	332	545
20	West.	CW	748A	575
20	West.	CW	748A	575
20	West.	CW	748A	575
15	Gen. Elec.	I-M		1725
15	Gen. Elec.	ITC		1725
10	Gen. Elec.	MT		1725

25 CYCLE, 3 PHASE, 440 VOLTS

H.P.	Make	Type	Serial	RPM
150	Gen. Elec.	MT563Y	5056230	725
125	Gen. Elec.	I-17	4550934	360
50	Gen. Elec.	MT547	5264084	720
50	Gen. Elec.	MT353	3879210	750
50	Allis-Chal.		7923K	715
52	Gen. Elec.	ITC5013	1773223	700
40	Gen. Elec.	MT543	4817983	750
40	Gen. Elec.	MT343	3887755	750

GENERATOR & EXCITER

1—62½ KVA 3 ph. 60 cy. 240 v. 1200 rpm Allis-Chalmers generator, serial No. 113797, with exciter, direct Connected stock No. E11317. Comp. with Base Pulley and Panel.

ERIE ELECTRIC CO., INC.

124 CHURCH ST. BUFFALO, N. Y. CL. 4758

POWER PLANT EQUIPMENT CO., INC.

39 Cortlandt Street
New York, N. Y.

A C TURBINE UNITS

10,000 KW General Electric
7500 KW (2) General Electric
5000 KW Westinghouse
4000 KW (2) General Electric
4000 KW Westinghouse
2500 KW General Electric
2000 KW (2) Westinghouse
2000 KW General Electric
1500 KW Allis Chalmers
1250 KW G. E. (bleeder)
1000 KW General Electric
1000 KW Wghse. (bleeder)
750 KW Al. Chal. 550°.
750 KW Al. Chal. (mixed pres.)
750 KW G. E. (bleeder)
625 KW Al. Chal. (bleeder)
500 KW Allis Chalmers
500 KW G. E. (bleeder)
300 KW (2) General Electric
250 KW Elliot.
125 KW Westinghouse

W T BOILERS

728 HP Erie City, 200 lbs.
600 HP (8) B & W 200 lbs.
500 HP Heine 200 lbs.; used 8 years.
500 HP (2) Heine, 225 lbs.
484 HP Springfield, cr drum, 200 lbs.; used 1900 days.
400 HP (2) Heine, cr drum, 160 lbs.
389 HP Sterling 200 lbs.; new 1929.
344 HP (2) Heine cr. drum; 165 lbs.
252 HP Combust. Engr'g; 160 lbs.—with Detroit Roto Stoker—New 1933.
300 HP Heine; 175 lbs.; new 1927
300 HP (2) B & W 200 lbs.

NON-COND. A.C. TURBINE UNITS

500 KW Westinghouse.
300 KW (2) General Electric
250 KW C. W.—Moore, 450 lbs.
100 KW Wghse.; 40 lbs. b.p.
60 KW Allis Chalmers
30 KW Westinghouse

A. C. UNITS

500 KVA G.E.-Skinner Unif.
312 KVA G.E.-Skinner Unif.
312 KVA G.E.-Chuse Uniflow.
312 KVA G.E.-Fitchburg, 150 rpm.
250 KVA G.E.-Corliss.
250 KVA G.E.-E.B. 4 V.
200 KVA G.E.-Al. Chal. Corliss.
150 KVA G.E.-Skinner Unif.
100 KVA G.E.-Skinner Unif.
60 KVA G.E.-Skinner Unif.

DIRECT CURRENT UNITS

300 KW 250 V.-Murray Corliss
300 KW 250 V.-Skinner Unif.
200 KW G.E. 125 V.-E.B. 4 V.
150 KW 250 V. G.E.-Skinner Unif.
100 KW 250 V. E.B.-4 V.
100 KW 125 V. G.E.-E.B. 4 V.

Oil Heating and Pumping Unit: suitable for 1000 to 5000 HP in boilers.

Engine: 22 x 36 Nordberg Uniflow; (twin) 20 x 21 Skinner Uniflow (15 to 20# b.p.)

ENGINES
GENERATOR SETS
DIESEL AND GASOLINE

New and Re-built

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OIL SWITCHES
AIR CIRCUIT BREAKERS

ELECTRIC EQUIPMENT CO.
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THE MORECO BARGAIN CORNER

125 KW, G. E. 125 v. D.C. M.G. Set with 3 ph. 60 cy. 1200 RPM, squirrel cage G. E. M. D.
75 KW, G. E. 125 v. D.C. 3 bearing M.G. Set driven by 2200 v. 3 ph., 60 cy. 1200 RPM mtr.
35 KW, Westinghouse, M.G. Set 125 volt D.C. generator driven by 54 H.P. 220/440 volt 3 phase, 60 cycle, 1200 RPM CS motor.
300 amp. 40/0 volt Lincoln Welder with 10 HP 220 volt, D.C. motor.

THE MOTOR REPAIR & MFG. CO.
1556 Hamilton Ave. Cleveland, Ohio

TURBOS 60 Cycle

7500 KW GE Curtis 60/3/6600/1800 RPM/175#—Surface Condenser

5000 KW GE Curtis 5-stage 60/3/13200/3600—200/225#—Jet Condenser Limited log service

1—4000 KW GE 60/3/6600/1800 RPM—150#—Surface Condensers

2—3000 KW Wemco Parsons Single Flow Reac 60/3/4400/1200—Surface Conds.

3125 KVA Lynn Type GE Rigid Frame 60/3/2300/3600 RPM. Surface Condenser.

2500 KVA Wemco Imp & Reac 60/3/2300/3600 RPM. Surface Condenser. Rare short log service.

937 KVA GE Bleeder 60/3/2300/3600 RPM 200#. Condenser.

√ 2—625 KVA Wemco 10-C Parsons or NC 60/3/440/2200/3600 —Jet Condenser—Surface avail.

300 KW Wemco Single Wheel Re-entry 60/3/240—120/250#.

TURBOS 25 Cycle

6000 KW GE Curtis 25/3/6600/1500 RPM—Jet Condenser—Surface avail.

2—6000 Wemco Impulse & Reaction Semi-Double Flow—25/3/2300 & 13200—Surface Condenser

2—3500 KW Imp & Reac 25/3/13200—Surface Condenser.

2—1500 KW Wemco 25/3/2400/1500—Condensers.

MOTOR GENERATORS

1500 KW Type MPC 60/3/4000: 600 volts—360 RPM

Several 500's also available 250—600 volts

BOILERS

2—1,000 Hp. Edgemoor ASME identified 200# Box steel header straight Tube Water Tube Boilers, oil fired, practically brand new, one never operated; one operated few months only on experimental program.

8-600 HP B&W Vertical Steel Header Long. 3-drum 200# Superheater and Taylor Stokers.

3—500 HP Edgemoor Steel Header Boilers—200#—Foster Superheaters

7—400 Hp. Stirling Water Tube Boilers, 200# Diamond soot blowers, Foster Superheaters.

√ 1—389 HP B&W Stirling Water Tube ASME and Hartford—200#—Stokers and all auxiliaries

ROTARY CONVERTERS 60 Cycle

2—1000 KW Wemco 60/6/650 DC—900 RPM

ROTARY CONVERTERS 25 Cycle

3500 KW GE Syn Booster 3/6 ph—250 DC—167 RPM—Transformers 11000: 196 volts.

√ 1—2000 Wemco Shunt Wound Booster Type Syn 25/3/191: 270 DC—300 RPM Transformers 4000:191 volts

FREQUENCY CHANGERS: 2000 KVA, 62½ cy.; 1000, 3000 KW, 60 cy.
CONDENSERS-SURFACE:—25000 to 1000 sq. ft.
MOTOR GENERATORS: 60/25 cycles 1500 to 300 KW
MOTORS: 60 cycles 4000-1000 HP.
TRANSFORMERS: 60/25 cycles—15000 to 500 KW
TURBOS: 4000-300 KW 60 cycles—many choice units not listed.

Pressure activity and commitments of World War #2 have snapped up 80% stock on hand. Recommend phone command to bind above available units.

REBUILT POWER EQUIPMENT—Ready to Ship

A.C. and D.C. MOTORS—1 H.P. to 1,000 H.P.

MOTOR GENERATOR SETS
3 ph. 60 cy.—Synchronous

100 kw. West. 250 v. 900 rpm., 2200/3/60 900 rpm.
1—100 kw. Westg. 250 v. DC 2300/3/60 Syn.

ENGINE GENERATOR SETS

175 kw. G.E. 2200/3/60 dir. con. Ridgway Engine.
300 kw. West. 250 v. DC dir. con. Skinner Automatic Uniflow.

ROTARY CONVERTER

100 kw. G.E. Synchronous 275 V. 1200 rpm. 2300/4000 transformers.

100 HP. LIDGERWOOD HOIST

Double drum Speedwell 2500 lb. pull at 450' per min. direct driven by 100 hp. A.C. or D.C. Motor.

A.C. GENERATORS

219 kva. G.E. 2300/3/60 200 rpm. 80% P.F. (Can be reconnected 440 or 220 v.)
125 kva. West. 2300/3/60 900 rpm.

SPECIALS IN SLIPRING MOTORS
3ph. 60 cy.

HP	Make	Speed	Type
750	Cr. Wh.	250	601
700	G.E.	393	MT-432
400	West.	1170	CW
260	Burke.	600	EM-65
250	G.E.	590	I-174
200	West.	690	CW-956A
150	G.E.	580	I
100	West.	1750	CI

SYNCHRONOUS MOTOR

225 HP. G.E. 2200 v. 3 ph. 60 cy. 80% P.F. (Can reconnect 440 or 220 v.)

A.C. MOTORS—3 ph. 60 cy.

HP	Volts	Make	Type	Speed
150	220/440	West.	CS	1800
150	2300	West.	Syn.	900
200	2200/440/220	West.	CS	250
200	2200	G.E.	IK-15	1200
200	220/440	West.	CS	1200
200	220/440	West.	CS	720
200	220/440	West.	CS	600
225	2200	West.	CS	900
250	220/440	West.	CS	900
250	2200	West.	CS	1200
275	2200	West.	CS	1800
300	220/440	West.	CS	1150
300	2300	West.	CS	1200
300	2200/440/220	West.	CS	450
350	2200/440/220	West.	CS	450
400	2200/440/220	West.	CS	500
450	2200/440/220	West.	CS	600
500	2200/440/220	West.	CS	720
600	2200/440/220	West.	CS	900

230 V. VARIABLE SPEED MOTORS

HP	Make	Type	Speed
25	West.	SK	825/1625
20	West.	SK-133	575/1150
15	Louis Allis	NA	1150/1750
15	West.	SK-100L	600/1200
10	G.E.	LC	625/1250
10	Reliance	TF-78	500/1509

GAS ENGINE GENERATOR SET

75 kw. West. 250 v. belted to 110 HP 2 cyl. Bessemer Gas Engine.

SPEED REDUCERS

14—3 HP. 400 Ah. Cleveland ratio 60:1.
23—3 to 5 HP. Thomas 2 speed ratio 1 side 100 to 1 other side 5 to 1.
5—10 HP. 600 At Cleveland ratio 90:1.
1—150 HP. R.D. Nuttal ratio 1.6:1.

AIR COMPRESSORS

2— 15 cfm G.E. 90# pres. 2300 D.C.
1— 50 cfm Sullivan 1 cyl. horiz. 100# pres. 6x6.
1—485 cfm Ingersoll-Rand 14-10 single cyl. horiz. 60#.

SERIES WOUND MOTORS—230 V. D.C.

1—5 HP. G.E. CO-3, 725 rpm.
1—10 HP. G.E. CO-7½, 6500 rpm.
2—25 HP. Milwaukee 400 rpm.
1—50 HP. G.E. MDS106, 600 rpm.
3—50 HP. West. 38B, 500 rpm.

TRANSFORMERS—1 ph. 60 cy.

1—100 kva. West. 2200-220/110.
2—75 kva. Burke 2200-110 v. 3 ph.
1—50 kva. Burke 2200-110 v. 3 ph.
3—37½ kva. West. 22000-2200.
2—25 kva. G.E. 2300-220/440.
6— 10 kva. Pgh. 2200-220/110.

FURNACE TRANSFORMERS

1—1500 kva. West. 2200 v. 3 ph. 60 cy. 106 v. sec.
2—3300 kva. G.E. 6600 v. 3 ph. 60 cy. 110 v. sec.

TURBINE

1—Kerr Economy Steam Turbine 450 B.H.P. 3800 rpm. 5" intake, 12" exhaust with Kerr Reduction Unit 3800 to 720 rpm. 115 lbs. pres.

DUQUESNE ELECTRIC & MFG. CO., Pittsburgh, Pa.

PROMPT SHIPMENT FROM OUR WAREHOUSE

750 KW TURBINE
Westinghouse Mixed Pressure 110# H. P. 2 to 4" L. P. 3600 RPM with gear box to 900 RPM with accessories. (Formerly connected to 750 KW 250 v. 900 RPM Gen.
(Will also rate 900 HP 75% P.F. Syn. Motors)

M-G SETS 3 ph. 60 cy. (Syn.)
3—150 KW G.E. 500 v. DC—2200 v. AC 1200 RPM .8 P.F. ATI
150 KW Ridg. 275 v. DC—2200 v. AC 900 RPM
150 KW West. 550 v. DC—2200 v. AC—1200 RPM
2—100 KW G.E. 275 v. Type MPC cp. wd. interpoles dir. con. to 150 HP G.E. 70% Leading P.F. Type ATI 2330 v. 3 ph. 1200 RPM Syn. Motors. With or without switchboard panels.
90 KW Allis 250 v. DC—2200 v. AC 900 RPM
75 KW Westgh. 250 v. DC—2200 v. AC 900 RPM

ENGINE GENERATOR SETS
100 KW 250 v. DC. Westgh.—Skinner Engine

SYN. MOTORS 3 ph. 60 cy.

HP	Make	Volts	Speed
350	A.C.	2200	600
2-175	Westgh. .8 P. F.	2200	600
2- 75	G.E.	2200	900
75	Westgh.	220	1800

SLIP RING & SQ. CG. MOTORS (3 ph. 60 cy.)

HP	Make	Speed	Wdg.	Type
700	G.E.	393	S.R.	MT432
400	West.	500	S.C.	CS
300	West.	490	S.C.	CS
200	West.	580	S.R.	CW
200	Cr. Wh.	440	S.R.	28
200	G.E.	700	S.R.	I M
200	Al. Ch.	600	S.C.	
150	West.	720	S.C.	CS
125	Al. Ch.	435	S.R.	
100	G.E.	720	S.C.	I K
100	F. M.	600	S.C.	BB
75	G.E.	690	S.R.	I M
75	West.	900	S.R.	CW752C
75	West.	690	S.R.	CW754C
75	West.	575	S.R.	CW868A

DC VARIABLE MOTORS (230 VOLTS)

HP	Type	Make	Speed
20	SK	Westgh.	900/1800
10	SK	Westgh.	600/1200
5	SK	Westgh.	450/1800

300 HP D.C. VARIABLE SPEED MOTOR
Westgh. 230 v. 250/500 RPM interpole #8099644

AC GENERATOR
219 KVA G.E. TRE 2400/480/240 v. 3 ph. 60 cy. 200 RPM with exc.

AIR COMPRESSORS
846 cu. ft. 65# Ing. Rand 2 stage ERI
550 cu. ft. 100# Bury 2 stage
355 cu. ft. 100# Laidlow Dunn
160 cu. ft. Chic. Pneu. 100#
140 cu. ft. Gardner Rix 100#
67 cu. ft. Ing. Rand ER 1 100#

HOISTS
75 HP Ottumwa sgl. fr. drum 36" dia. 30" wide 8" flanges geared 75 HP CI Westgh. slip ring motor with rev. drum control
75 HP Lidgerwood sgl. fr. drum
50 HP Diamond 2 drums same shaft
30 HP Clyde sgl. drum AC motor
25 HP Thomas sgl. drum AC motor
15 HP Lidgerwood sgl. dr. AC motor

OIL ENGINE DRIVEN AIR COMPRESSOR
Chicago Pneumatic simplate-valve Type NS03 straight line 16½" & 11" x 18" cap. 492 cu. ft. 100# pres. with air receiver and starting air compressor.

In addition to the Above We have Hundreds of Other Items in Stock—Kindly Send Us Your Inquiries

MOORHEAD-REITMEYER CO., INC., Pittsburgh, Pennsylvania

FOR SALE BY OWNER

ROTARY CONVERTER
General Electric 3,500 KW, 6 phase, 25 cycle, Rotary Converter, #1353004 — Booster type, 240-310 volts DC—18 pole and inter poles, 20,000 amps DC circuit breaker—AC breakers, 3,850 KVA Transformers.

TRANSFORMERS—Oil Cooled
2—10,000 KVA, 3 phase, 26,400/13,200/46,00/2300 volts, oil cooled.

CIRCUIT BREAKERS—Oil and Air
500—Various Circuit Breakers up to 4,000 amps. including relays; Current and Potential Transformers—Solenoid and Hand Operated.

RELAYS
Over 1,000 Relays of all types for all services for circuit breakers, motors, tripping, etc.

BOILERS
4—600 HP 3-300 HP B&W Watertube Superheaters, Stokers, 225# working pressure.
2—300 HP, 225# working pressure, Watertube Boilers, Oil Fired, Complete.

TURBINES
2—450 HP Turbine 3600 R.P.M.

What have you for sale? Single Units. A complete plant? We will buy it and you will profit. Get in touch with Howe Brothers.

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324-328 Pearl Street New York, N. Y.
Telephone Nos.—Worth 2- 2708—2709—2710

—TRANSFORMERS—

TRANSFORMERS WANTED

in operating condition or burnt out. Mail us list giving complete nameplate data and stating condition.

We Rewind, Repair and Redesign all Makes and Sizes
ALL TRANSFORMERS GUARANTEED FOR ONE YEAR
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"AMERICA'S USED TRANSFORMER CLEARING HOUSE"
STATION M Since 1912 CINCINNATI, OHIO

ROTARY CONVERTERS

2—500 KW General Electric late type, form P, Rotary Converters, 250 volt DC, switchboards and all necessary switchgear, 2300 volt transformers.
1—200 KW General Electric Rotary Converter, switchboards and switchgear, 2300 volt transformer.

Above sets guaranteed. Offered at low prices for immediate disposition.

COAL MINE EQUIPMENT SALES COMPANY
306 Beasley Bldg. Terre Haute, Indiana

HART and CROUSE COMPANY

3 BOILERS

1—#410 Royal smokeless sectional water tube boiler of 65 B.H.P. at 15# steam pressure double grates, upper set water circulation and lower rocker pattern.
2—#S557 Royal smokeless sectional water tube boilers of 150 B.H.P. at 15# steam pressure, double grates, upper set water circulation and lower rocker pattern, with duplex automatic water feeder.

All used only four heating seasons.

BOYERTOWN BURIAL CASKET CO.
BOYERTOWN, PA.

G.E. SLIPRING MOTORS, 60 Cy., 3 Ph.

Quan.	HP	Volt	Speed	Type	Frame
6	300	550	600	HITC	5017A
6	200	550	600	HITC	5015A
10	75	550	600	HITC	5013A

G.E. SQUIRREL CAGE MTRS, 60 Cy., 3 Ph.

3	100	2200	600	I	15A
1	40	2200	1800	KT	527
4	30	2200	1200	KT	332
3	25	2200	1200	KT	326
10	15	550	1200	KT	302

G.E. OIL CIRCUIT BREAKERS
17—60 Amp., 2200 Volt, FK 20
1—100 Amp. 23000 Volt automatic reclosing equipment
1—20 KW. G.E. 60 Volt Generator, 30 HP 440 volt motor
17—500 KVA transformers, G.E. 23000/600 Volt, 3 Phase, 60 Cycle

PENSACOLA COMPANY
1100 Fourth Street Berkeley, California

MOTORS

2300 volts 3 phase 60 cycle
1—225 HP. General Electric K 600 rpm.
2—200 HP. General Electric MT 1200 rpm.
1—200 HP. Westinghouse CW 600 rpm.
2—200 HP. General Electric L 600 rpm.
1—150 HP. Allis-Chalmers 1800 rpm.
3—75 HP. General Electric K 514 rpm.

ANDREN-MYERSON CORP.
411 Atlantic Ave. Boston, Mass.
Liberty 4300

BOILERS

1— 50 H.P. Upright Boiler
1— 60 H.P. Locomotive Type Boiler
1— 80 H.P. Ames Boiler
1—100 H.P. Vertical Boiler
1—125 H.P. Locomotive Type Boiler
1—150 H.P. Economic Boiler
1—250 H.P. Scotch Marine Boiler
1—300 H.P. Scotch Marine Boiler
1—500 H.P. Scotch Marine Boiler

Industrial Machinery & Supply Co.
217 E. 5th St. N. Y., N. Y.
Orchard 4-1089

FOR SALE
TURBO GENERATOR units, Cond. 3/60/2300 v. 2—1000 KW. 1—750 KW. 1—1500 KW. Bleeder 3/60/440 v. 1—500 KW. 1—300 KW. DIESEL PLANTS; 600 KW. & 400 KW. 440 v.
BOILERS
STEPHEN A. DOUGLASS CO.
630 Fort Washington Ave., New York, N. Y.

COMPLETE POWER PLANTS

Water Tube Boilers:— 12,000 HP. sizes 114—300—400—500—600—700—1000—1200 HP
Turbo-Generators:—Both A.C. & D.C., to suit most conditions—100 KW to 30,000 KW
ENGINE—GENERATORS AND DIESEL SETS—50 to 1200 KW
STEAM—ELECTRIC—DIESEL
CHARLES B. REARICK 30 CHURCH ST., NEW YORK

SLIP RING MOTORS, 3 PH., 60-CY.

HP	Volts	Make	Speed
500	2300	Whse.	450
300	440–220	G.E.	1800
300	2300–4000	G.E.	1200
250	440–550	G.E.	600
200	2200–550	G.E.	1800
200	2200–440	G.E.	600
150	440–220	G.E.	1800
150	2200	G.E.	900
150	2200–440	Whse.	1800
150	220–440	G.E.	1800
100	220–440	G.E.	500
100	220–440	G.E.	720
100	440–220	G.E.	600
100	220–440	G.E.	900
80	220–440	G.E.-MTC	900
75	440–220	G.E.	900
60	220–440	G.E.	720

SYNCHRONOUS MOTORS, 3-PH., 60-CY.

400	440–220	Whse.	276
350	440–220	G.E.	200
250	2300	G.E.	900
240	2300–440–220	G.E.	600
200	2300–4000	G.E.	1200
150	2200	G.E.	1800
100	440–220	G.E.	1200
50	220–440	G.E.	1200

TRANSFORMERS—60 CYCLE

3—400 kva., G.E. type H, 13200-440.
3—250 kva., G.E. type H-KD 23000-2300.
3—200 kva., G.E., H-KD 13200-2300.
3—200 kva., G.E. H-KD 6600-2300/4000Y., 25 cy.
3—100 Westinghouse, type SK, 22000/11000-2300.
1—100 kva., Pittsburgh, type OISC 2400-240-120.
3—200 kva., G.E., type H-KD, 13800-230/460.
3—100 kva., Whse type, SK, 2300-230/115
3—100 kva., G.E., type H-KDD, 6900/11950Y-230/115.
3— 50 kva., G.E. type H-KS 2300-230/460.
3— 50 kva., G.E. type H-K 2300-230/115.
3— 50 kva., Pittsburgh, 13800-240/120.
3— 50 kva., Moloney, 2300-230/115.
6— 50 kva., Whse type SK, 13800-240/120.
3—37½ kva., G.E., type H-K 2200-460.
3—37½ kva., G.E., type H-K, 2300-230/115.
3— 25 kva., G.E., type H-K 2300-230/460.
3—25 kva., Whse type S 2300-575

A. C. GENERATORS

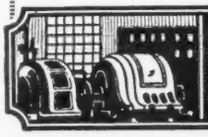
1—500 KVA, 900 r.p.m. 2200 V. Whse. Condenser.
1—312 kva., 900 r.p.m., 2300-V., Westghse.
1—300 kva., 600 r.p.m., 240-480-V., G.E.
1—225 kva., 600 r.p.m., 2200-240-480-V., G.E.
1—219 KVA, 200 r.p.m., 480 V. Whse.
1—187 kva., 900 r.p.m., 2200-550-V., Westghse.

SQUIRREL CAGE MOTORS

HP	Volts	Make	Type	Speed
500	440/220	G.E.	IK	1200
500	440/220	G.E.	IK	900
400	2200	Whse.	C.S.	1800
300	2300/440	G.E.	IE-K	1200
300	2200	G.E.	IE-K	1800
250	2200	G.E.	IE-K	1800
250	2200	G.E.	I-K	600
230	220/440	G.E.	I-K	720
200	220/440	G.E.	IK	720
150	2200	Allis Ch.	AN	450
100	2200	G.E.	IE-K	1800
100	550	G.E.	KT	900
100	220/440	G.E.	KT	720
75	2200	G.E.	KT	1200
75	2200	G.E.	KT	900
75	2300	G.E.	IE-K	1800
50	220/440	G.E.	K	1800

MOTOR GENERATORS SETS

1—100 KW., 125 V., 1200 R.P.M. Elec Machy., con. to 120 KVA., 4150/2400 V., 3 ph., 60 cy., Syn. motor.
1—35 kw., 125 V., 1200 r.p.m., G.E., type RC, conn. to KT 50 HP. 220/440 V. 3 ph. 60 cy.
1—G.E., 3 unit set, consisting of 1 type R.C., 10 KW, 250 V., 1750 RPM, and 1 R.C., 10 KW, 125 V. Generators, coupled to K.T. 35 H.P., 220/440 V., 3 ph., 60 cy., S.C. motor.



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Power & Dist. Transf. from one to 5000 KVA. Any Volt or Frequency.

Motors, Generators, Turbines, Centrifugal Pumps, etc.

A.C. & D.C. Elec'l Meters, Potential & Current Transf. All Makes. Scales Calibrated to your requirements.

Catalog & Prices on Request

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UNDERWRITER'S FIRE PUMP

750 G.P.M. Lea-Courtney Motor Driven Centrifugal Fire Pump. 2 Stage, 231' Head. 8" Suc. 6" Dis. Complete with A.C. Motor, Panel and Underwriter's equipment.

Immediate Shipment.

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1000 KW 200# 2300 V. **Turbine Boilers** also avail.
2—745 HP 200# **ASME Boilers.** 125 deg. Superheat.
50-75-100-125 HP **Firebox Type Boilers.** 100/250#.
30 ton Standard Gauge **Plymouth Gas Locomotive.**
800 HP 520 KW **Busch Sulzer Diesel Generator.**
120 HP 90 KVA **Fairbanks Morse** 2300 V. **Diesel**
100 & 144 KW **Skinner Uniflow Generator Sets.**
100 HP **Fairbanks Morse Oil Engine** with clutch.
5000 HP **Hoppes Feedwater Heater,** 10# pressure.
80 HP **American** 3 Drum & **Swinger Elec. Hoist.**
#600 P & H **Gas Crawler Crane** with 50 ft. boom.

Mississippi Valley Equipment Co.
507 Locust St. St. Louis, Mo.

"What do you Need or Have to Sell?"

SYNCH. MOTOR GENERATORS

300 KW G.E. 250 V. 2300/4000 A.C. 1200 RPM
300 KW WEST. 250 V. 2300/4000 A.C. 1200 RPM
215 KW A.C. 250 V. 2300/4000 A.C. 1200 RPM
200 KW G.E. 250 V. 2300/4000 A.C. 1200 RPM
150 KW R.W. 250 V. 2300 A.C. 1200 RPM.
100 KW WEST. 250 V. 2300 A.C. 900 RPM

SYNCHRONOUS CONVERTERS

500 KW WEST. 250 V. 2300/4000 A.C. 1200 RPM
300 KW G.E. 250 D.C. 2300/4000 A.C. 1200 RPM
300 KW G.E. 600 D.C. 2300/4000 A.C. 1200 RPM
200 KW G.E. 250 D.C. 2300/4000 A.C. 1200 RPM
200 KW WEST. 250 D.C. 2300/4000 A.C. 1200 RPM
200 KW R.W. 250 D.C. 2300/4000 A.C. 1200 RPM
150 KW R.W. 250 D.C. 2300/4000 A.C. 1200 RPM

Each unit listed above is owned by us and is Available now for immediate purchase.

WALLACE E. KIRK CO.
Incorporated
502 Grant Building Pittsburgh, Pa.

1200 LBS. PRESSURE AIR OR GAS COMPRESSOR

Worthington, Air or Gas Compressor, three stage, tandem, 164 CFM, 1200 lbs. pressure, with all equipment, steam driven, could be arranged for electric drive.

Excellent Condition

DENNY & CLARK
910 No. Marshfield Av., Chicago, Ill.

ENGINE GENERATOR SET

1—200 KVA, 60 cy., 240 V., 2 ph. (will reconnect for 3 ph.) 200 rpm, Crocker-Wheeler to a 16x22 Erie Ball 4 valve engine with direct connected exciter and switchboard.

MOTOR GENERATOR SETS

1—150 KW, 275 V., 900 rpm, type SK, Westgh. to a 225 HP, 3 ph., 60 cy., 230 V., unity P.F., Westgh. syn. motor with A.C. and D.C. panels.
1—300 KW., 275 volt, 720 RPM., Gen. Elec., type MPC, to a 430 HP., 3 phase, 60 cycle, 2300 v., ATI Gen. Elec. syn. motor with A.C. and D.C. panels.

TURBO GENERATORS

1—937 KVA, 750 KW, 3 ph., 60 cy., 2300 V., 3600 rpm, Gen. Elec. complete with C. H. Wheeler surface condenser, pumps, radojet.

The above are just a few of the thousands of items we have in Motors, Generators, Turbo Generators, Engine Generators, Motor Generators, Transformers, Circuit Breakers, etc. Please send us your inquiries. What have you for sale?

GEORGE SACHSENMAIER CO.
8403 Hegerman St. Phila, Pa.

TRANSFORMERS

A new Lot of Reconditioned Transformers acquired—200KVA and down. Let us have your inquiries.

Electric Apparatus Repair Co.
Specialists on Rebuilding Motors, Generators and Controls
1410 No. 6th St., PHILA., PA.

300 KW ROTARY CONVERTER

1—300 KW Burke Rotary Converters, 250 volts D.C., rolled steel frames, 6 phase, 60 cycles with transformers and swbds.

ADJUSTABLE SPEED MOTORS

2—50 H.P. Crocker Wheeler Type CMC Size 65 H Adjustable Speed Motors, 230 volts D.C., 400/1200 R.P.M., with Rollway Roller Bearings.

75 KW MOTOR GENERATOR SET

2—75 KW GECo Induction MG Sets, 250 V-DC, 3-60-220/440 V-AC, 1200 RPM, with switchboards.

300 KW ROTARY CONVERTER

1—300 KW Westinghouse Rotary Converter, 600 volts D.C. 6 ph., 60 cy., pedestal bearings, 1200 RPM.

ELECTRIC EQUIPMENT FOR INDUSTRY

WRITE FOR STOCK LIST ON

CONSTANT SPEED MOTORS D.C.
ADJUSTABLE SPEED MOTORS D.C.
MILL & CRANE MOTORS D.C.
SQ. CAGE & SLIP RING MOTORS A.C.
SYNCHRONOUS MOTORS A.C.
TRANSFORMERS

CRANE MOTORS

1—MDS 109½, 1—MC90, 3—38-B, 1—CO 1812, 1—MDS 108, 1—CO 2007, 3—CO 2004, 3—CO 2002, 2—12A, 1—48

300 H.P. MILL MOTOR

1—300 HP GECo Type MPC form A Mill Motor, 230V-DC, 500 RPM, comp. wound, mag. rev. control.

ELECTRIC FURNACE

1—300# Detroit Electric Furnace, Type LFA for 440 volts A.C. Used 6 months.

FREQUENCY CHANGER

1—625 KVA West., 3 ph., 62½ cy., 480/2300 v., 750 RPM, 750 HP, 3 ph., 25 cy., 4000/2300 v., starts from either end. Comp. switchboards.

FREQUENCY CHANGERS — TURBO GENERATORS — AC & DC MANUAL MAGNETIC CONTROL — CENTRIFUGAL PUMPS — AC & DC SWITCHBOARDS

FOR DETAILS, WRITE: **JOHN D. CRAWBUCK CO.** 406-7 EMPIRE BLDG. PITTSBURGH, PENNA.

"BEHRS" GUARANTEED REBUILT EQUIPMENT

3000 **Electric Motors,** 1 H.P. to 200 H.P.
Blowers—all types and sizes

SPECIAL
2000'—2 Pd. G.E. **Positive Pressure Blower** M.D. 27 H.P. 3 ph. 60 cy. 220/440

Boilers—High and Low Pressure
Compressors—5 to 500 cu. ft.
Pumps—steam and electric
Metal and Woodworking Machinery.
MAIL US YOUR INQUIRIES

JOS. BEHR & SONS, Inc.
Machinery & Industrial Equipment
1120 Seminary St. ROCKFORD, ILL.
We Buy and Sell

800 HP SYN. MOTOR

NEW 2200V. 60 Cy. 3 Ph. 180 Rev.
6 New Fans—66750 CFM. 2" to 6" S.P.
4 Nicrome Steel Plates (Heat Resisting)
1500 CFM. 2 Stage Comp. Syn. Motor Dr.
4 Pumps 4166 GPM. 162' Hd., 250 HP Motors
6 Hot Metal Ladles, 120 Ton—3-50 T.
20000 Firebrick 14½"x4½"x2½"x1½"
3—100 KW 125-250V DC Non Cond. Turbos
1800 HP. Red. Gear 7.7 to 1.0
Large Quan. Stoneware Pipe and Fittings

ROSS POWER EQUIP. CO.
Indianapolis, Indiana

ENGINE GENERATOR SET

300 KW Nordberg Unaflow Engine Generator Set. 230/115 Volts D.C. On Original Foundation Complete. Purchased new in 1924 A-1 Condition.

Paul Jay Electrical Machy. Corp.
672 Bergen St. Brooklyn, N. Y.

ENGINE GENERATOR SETS

1—160 **KW West.** 3/60/480 Belted Exct. Dir. con. Cluse left hand 4 val. non-release eng. 17x21.
1—312 **KVA West.** 3/60/2300 v. belt, exct. dir. con. Murray Special Corliss left hand eng. 18x30.

AIR COMPRESSORS

1—610 c. ft. **I.R.** St. Dr. 100# air, 150# stm.

SURFACE CONDENSERS

2—10 AD 4 pass 210 ft. **Foster Wheeler** over Comb. Air Circulating and Tail pump.

STEAM PUMPING ENGINES

1—**Snow** 6 mgd C&FW Cr. Com. Opp. Type Cond. 20-40x13¾x36, with waterwork type cond.
1—**Allis-Chal.** 4 mgd. cr. com. cond. Size 12x28x13x24. Fine cond.

PUMPS

Worth Dup. Pump size 16x12x12, cap. 1100 gpm. heavy water wks. type.

BIRCH MANUFACTURING COMPANY
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For Sale— ELECTRIC MOTORS

1—60 HP, Wagner, 900 rpm, late type, ball bearing motor, Sq. Cage.
1—75 HP, Allis-Chalmers, 720 rpm, Sq. Cage motor.
1—100 HP, G.E. 900 rpm, MT-356, slip-ring motors.
1—100 HP, Westinghouse, 720 rpm, Type CW, slip-ring motor.
1—150 HP, Gen. Elec., 600 rpm, Type I-M, slip-ring motor.
1—200 HP, Gen. Elec., 720 rpm, Type ATI, synchronous motor.
1—300 HP, Elliott, 580 rpm, Type 32 NX, Sq. cage motor.
1—500 HP, Gen. Elect., 450 rpm, Type I, slip-ring motor.

All 3 Phase, 60 cycles, 220 or 440 volts. Each complete with necessary control. Prompt delivery from our stock.

AIR COMPRESSORS

1—9x8 Sullivan, Type WG-6, compressor, completely rebuilt.

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HIGH-PRESSURE ASME & NATIONAL BOARD

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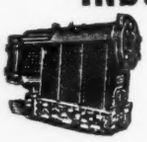

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All makes & sizes for prompt shipments

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3—525 H.P. 200# Springfield Cross Drum Boilers.

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1—180 H.P. **Allis-Chalmers,** Horiz. 2-Cylinder 16" x 24" Full Diesel Direct Connected to 156.5 Kva. 3/60/2300-Volt Generator.
1—280 H.P. **De La Vergne,** Horiz., 2-Cylinder 20" x 34 Full Diesel Solid Injection, Direct Connected to 240 Kva G-E Generator 3/60/2300 V.
Both have Exciters, and Switch Boards
All Ready for shipment—Kansas City.
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THE FRED. W. KIEMLE CO.
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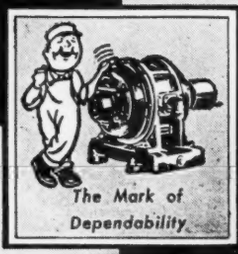
OVER 10,000 ITEMS IN STOCK FOR IMMEDIATE DELIVERY FROM EITHER ROCHESTER, N. Y. OR TOLEDO, OHIO REBUILT AND SOLD WITH A STANDARD NEW GUARANTEE.



MOTORS, GENERATORS, CONTROLS, TRANSFORMERS, MOTOR GENERATOR SETS, etc.

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395 STATE ST.
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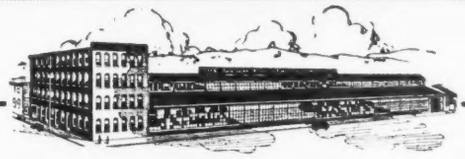

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120,000 SQ. FT. OF WAREHOUSE SPACE . .

. . . Housing our Complete Rebuilding Facilities . . . Also a wide range of Electric Motors and Power Plant Equipment

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HERE'S A PARTIAL LIST OF PRODUCTS WE HAVE AVAILABLE FOR *IMMEDIATE SHIPMENT*—A COMPLETE, DETAILED LIST MAY BE FOUND IN OUR CATALOG NO. 53 —*WRITE FOR IT!*

SPEED REDUCERS

2—350 HP, 900 RPM, Nuttal Helical Reduction Gear Units, 3.6 to 1 ratio, Type MR.

GAGE TYPE MOTORS

2200 Volts, 3 PH., 60 Cy.

2—150 HP, 3600 RPM, Allis-Chalmers, type ARW (New).
4—100 HP, 3600 RPM, Westinghouse, type CS, frame 935.6H.

STEAM ENGINE GENERATORS

2—300 KW Elliott, 250 volts, D.C., 165 RPM, connected to 21x28", 4 valve Automatic Type M Engines.

MOTOR GENERATOR SETS

3—500 KW General Electric, 600 volts, D.C., direct connected to 700 HP, 720 RPM, 2500/5000 volts, 3 phase, 60 cycle Synchronous Motor with direct connected exciters.

MOTOR GENERATOR SETS (Con't.)

1—250 KW Allis-Chalmers, 120 volts, 750 RPM connected to a 350 HP 2200 volt, 25 cycle, 3 phase, synchronous motor.
1—25 KW Westinghouse, 125/250 volt, d.c. to Type CS, 40 HP, 1750 RPM, 440 v, 3 ph, 60 cy. Mtr.
1—50 KW Allis-Chalmers, 125 volt, d.c. to cage type 75 HP, 1160 RPM, 2200 v, 3 ph, 60 cy Mtr.
1—50 KW General Electric, 125 volt, d.c. to Type KT, 75 HP, 440 v, 3 ph, 60 cy, 1150 RPM Mtr.
1—75 KW Ridgeway, 120 volt, d.c. to 110 HP, Synchronous, 3 phase, 60 cycle, 440 volt, 1200 RPM Motor.
1—100 KW General Electric, 125 volt, d.c. to Type AR, Allis-Chalmers, 150 HP, 440 volt, 3 phase, 60 cycle, 1160 RPM, cage Motor.
1—200 KW Allis-Chalmers, 125 volt, d.c. to Westinghouse, 350 HP, 2200 volt, 3 phase, 60 cycle, 900 RPM, synchronous motor.

THE GLOW ELECTRIC COMPANY

945 HARRIET ST. Phone MA. 3024 CINCINNATI, OHIO

Motor Generator Sets—Synchronous Motors, etc.

MOTOR GENERATOR SETS, 3 phase 60 cycle A.C.

100 KW West. Rotary 275 Volt D. C. 2300 Volt A.C.
75 KW West. M.G. Set 250 V. D.C. 440 V. A.C.
50 KW Allis-Chalmers 250 V. D.C. 2200 V. A.C.
15 KW Burke 125 Volt D.C. 220 Volt A.C.

SYNCHRONOUS MOTORS 3 phase 60 cycle

2—G.E. 700 HP 720 RPM 6600/4000/2300 Volt
Burke 300 HP 900 RPM 440/220 Volt
G.E. 200 HP 720 RPM 440/220 Volt
Ridgway 150 HP 1200 RPM 2300/440 Volt
Electric Machinery 150 HP 720 RPM 73 P.F. 440 V.
G.E. 125 HP 277 RPM 440/220 Volt
C.W. 100 HP 900 RPM 440/220 Volt
Fairbanks-Morse 75 HP 720 RPM 220 Volt
G. E. 60 HP 720 RPM 440/220 Volt

SLIP RING MOTORS 3 phase 60 cycle.

West. 150 HP 720 RPM 550 Volt
G.E. 60 HP 720 RPM 440/220 Volt
Allis-Chalm. 250 HP 600 RPM 440/220 Volt
Burke 100 HP 1200 RPM 440/220 Volt

ADJUSTABLE SPEED 230 Volt D.C. Motors

1—G.E. RF-18 90/120 HP 400/1200 RPM
2—Reliance 1400-T 100/125 HP 300/900 RPM
1—West. SK-140 100 HP 600/950 RPM
1—West. SK-180 45/90 HP 475/950 RPM
1—Diehl 50 HP 400/1200 RPM
1—Reliance 1400-T 50 HP 175/700 RPM
2—Crocker-Wheeler 125-H 50 HP 175/700 RPM
1—West. SK-143 40 HP 500/1500 RPM
2—Reliance 461-T 40 HP 475/1500 RPM
2—Allis-Chalm. 35/70 HP 450/1350 RPM
1—Allis-Chalm. 25 HP 600/1800 RPM
1—Reliance 230-T 20 HP 400/1600 RPM
1—G.E. CD-93 15 HP 500/1500 RPM
1—G.E. CD-103 15 HP 400/1600 RPM
2—West. SK-123 5 HP 300/1200 RPM enclosed

The Electric Motor & Repair Co., Cuyahoga Falls, O.

DIESEL ELECTRIC PLANT

With Auxiliary Equipment—Ready to Operate

1120 H.P. IN TWO FAIRBANKS-MORSE UNITS FULL DIESEL—MODEL 33 STYLE M. DIRECT CONNECTED TO 760 KW 2400 OR 600 VOLTS A.C. GENERATORS

Pedro J. Smith, Inc. **100 East 42nd St., New York City**

UNUSED BOILER AND STOKER FOR IMMEDIATE DELIVERY BY OWNER

KEELER WATER TUBE BOILER

Rated at 200 H. P. 2000 sq. ft. heating surface, 2 drums, type C. P. A. S. M. E. Code safe working pressure 160#. Floor space, overall length 19'—5", overall width 8'—6⅞", height, floor line to top steam nozzle, 12'—11⅞". Complete with valves, fittings, soot blower, tile insulation and casing, waterwall protection, brick work.

RILEY JONES STOKER

Heavy duty, underfeed, single retort, side dumping type. Width between side walls, 6'—6", length, 6'—4½". Equipped with hydraulic drive. Straight line ram feed, separate fan, motor and pump unit. Forced draft equipment and Cash automatic control. Feeding range 0 to 2100# of coal per hour.

This equipment is brand new (unused). Price $9,000, f. o. b. our warehouse, for immediate delivery.

DETROIT STEEL PRODUCTS COMPANY

2250 East Grand Boulevard, Detroit, Mich.

Re-built Motors and Generators

2—75 HP, 2200 V, **Fairbanks Morse,** 1800 RPM, 3 PH, 60 CY slip ring motor, direct connected to 500 GPM 3 stage 200' head pump.

1—400 HP **Westinghouse,** type CW, 3 PH, 60 CY, 440 V, 450 RPM slip ring motor.

3—350 HP **Allis Chalmers,** 3 PH, 60 CY, 440 V, 600 RPM slip ring.

1—300 HP **Allis Chalmers,** 3 PH, 60 CY, 440 V, 485 RPM slip ring.

2—250 HP **Westinghouse,** type CS1012, 3 PH, 60 CY, 440 V, 435 RPM sq. cage.

1—210 KVA **General Electric,** 3 PH, 60 CY, 2300 V, 225 RPM generator direct connected to an **Ames** Uniflow engine, with switchboard.

1—300 HP **Westinghouse** syn. 1 PF, 3 PH, 60 CY, 2200 V 600 RPM with direct connected exciter, 3 or 2 bearing.

2—150 HP **Allis Chalmers,** 3 PH, 60 CY, 440 V, 450 RPM slip ring.

2—150 HP **Westinghouse,** type CW, frame 1000, 2 PH, 60 CY, 440 V, 450 RPM slip ring.

2—100 HP **Westinghouse,** type CS, frame 754 C, 3 PH, 60 CY, 440 V, 870 RPM sq. cage.

3—150 HP **Allis Chalmers,** 3 PH, 60 CY, 440 V, 1750 RPM sq. cage.

1—150 HP **Westinghouse,** type CS, 3 PH, 60 CY, 440 V, 450 RPM sq. cage.

1—100 HP **Westinghouse,** type CCL, 3 PH, 60 CY, 2200 V, 1750 RPM sq. cage.

1—100 HP **Westinghouse,** type CW, frame 752 C, 3 PH, 60 CY, 440 V, 1150 RPM slip ring.

1—100 HP **Wagner,** type 26V5BP, 3 PH, 60 CY, 440 V, 860 RPM sq. cage.

2—100 HP **Allis Chalmers,** type ANY, 3 PH, 60 CY, 440 V, 690 RPM slip ring.

1—100 HP **Allis Chalmers,** type ANY, 3 PH, 60 CY, 2200 V, 690 RPM slip ring.

1—75 HP **Allis Chalmers,** 3 PH, 60 CY, 440 V, 450 RPM slip ring.

1—75 HP **Westinghouse,** type CW, 3 PH, 60 CY, 440 V, 720 RPM slip ring, 3 or 2 bearing.

1—75 HP **Fairbanks Morse,** type H, frame 165 C, 3 PH, 60 CY, 550 V, 900 RPM sq. cage.

2—75 HP, **General Electric,** type I, 3 PH, 60 CY, 220 V, 720 RPM sq. cage.

1—75 HP **Lincoln,** type IQ, 2 PH, 60 CY, 440 V, 600 RPM sq. cage.

1—75 HP **Finn-Weiksel (Wagner)** ty. 26VRN, 3 PH, 60 CY, 220 V, 1200 RPM syn.

1—250 HP **Crocker Wheeler,** type CCM, size 151 H, 230 V, 600 RPM, DC

3—100 HP **General Electric,** type CD, frame 123, 230 V, 1200 RPM DC

1—60 HP **General Electric,** type CD, frame 115, 230 V, 850 RPM, DC

1—50 HP **Westinghouse,** type SK, frame 160, 230 V, DC, 565 RPM

1—50 HP **General Electric,** Class 6, Form B, 600 V, DC, 600 RPM

1—60 HP **Westinghouse,** type SK, frame 160, 230 V, DC, 680 RPM

1—60 HP **C&C,** 230 V, DC, 250/1000 RPM

1—75 HP **General Electric,** type CD, frame 176, 550 V, DC, 250/1000 RPM

3—75 HP **Westinghouse,** type SK, frame 150, 230 V, DC, 1100 RPM

1—**Sprague** Dynamometer, type LC, 150 HP, 250 V, 2300/3500 RPM with new Toledo scale, no control panel.

1—100 KW **General Electric,** type DLC, 125 V, DC, 440 V, AC M-G set.

The Wente Electric Co.

207 N. Fourth St. Hamilton, Ohio

Est. 1903

Defense Savings Pay-Roll Allotment Plan

How company heads can help their country, their employees, and themselves

voluntary pay-roll allotment plan | helps workers provide for the future
helps build future buying power
helps defend America today

This is no charity plea. It is a sound business proposition that vitally concerns the present and future welfare of your company, your employees, and yourself.

During the post-war period of readjustment, you may be faced with the unpleasant necessity of turning employees out into a confused and cheerless world. But you, as an employer, can do something *now* to help shape the destinies of your people. Scores of business heads have adopted the Voluntary Pay-roll Allotment Plan as a simple and easy way for every worker in the land to start a *systematic* and *continuous* Defense Bond savings program.

Many benefits . . . present and future. It is more than a sensible step toward reducing the ranks of the post-war needy. It will help spread financial participation in National Defense among all of America's wage earners.

The widespread use of this plan will materially retard inflation. It will "store" part of our pyramiding national income that would otherwise be spent as fast as it's earned, increasing the demand for our diminishing supply of consumer goods.

And don't overlook the immediate benefit . . . money for defense materials, quickly, continuously, *willingly*.

Let's do it the American way! America's talent for working out emergency problems, democratically, is being tested today. As always, we will work it out, without pressure or coercion . . . in that old American way; each businessman strengthening his *own* house; not waiting for his neighbor to do it. That custom has, throughout history, enabled America to get things done *of its own free will.*

In emergencies, America doesn't do things "hit-or-miss." We would get there *eventually* if we just left it to everybody's whim to buy Defense Bonds when they thought of it. But we're a nation of businessmen who understand that the way to get a thing done is to *systematize* the operation. That is why so many employers are getting back of this Voluntary Savings Plan.

Like most efficient systems, it is amazingly simple. All you have to do is offer your employees the convenience of having a fixed sum allotted, from each pay envelope, to the purchase of Defense Bonds. The employer holds these funds in a separate bank account, and delivers a Bond to the employee each time his allotments accumulate to a sufficient amount.

Each employee who chooses to start this savings plan decides for himself the denomination of the Bonds to be purchased and the amount to be allotted from his wages each pay day.

How big does a company have to be? From three employees on up. Size has nothing to do with it. It works equally well in stores, schools, publishing houses, factories, or banks. This whole idea of pay-roll allotment has been evolved by businessmen in cooperation with the Treasury Department. Each organization adopts its own simple, efficient application of the idea in accordance with the needs of its own set-up

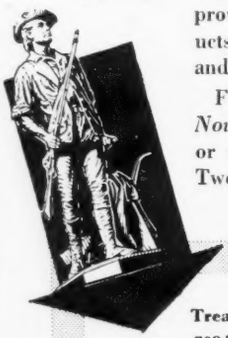
No chore at all. The system is so simple that A. T. & T. uses exactly the same easy card system that is being used by hundreds of companies having fewer than 25 employees! It is simple enough to be handled by a check-mark on a card each pay day.

Plenty of help available. Although this is *your* plan when you put it into effect, the Treasury Department is ready and willing to give you all kinds of help. Local civilian committees in 48 States are set up to have experienced men work with you just as much as you want them to, and no more.

Truly, about all *you* have to do is to indicate your willingness to get your organization started. We will supply most of the necessary material, and no end of help.

The first step is to take a closer look. Sending in the coupon in no way obligates you to install the Plan. It will simply give you a chance to scrutinize the available material and see what other companies are already doing. It will bring you samples of literature explaining the benefits to employees and describing the various denominations of Defense Savings Bonds that can be purchased through the Plan.

Sending the coupon does nothing more than signify that you are anxious to do *something* to help keep your people off relief when defense production sloughs off; *something* to enable *all* wage earners to participate in financing Defense; *something* to provide tomorrow's buying power for your products; *something* to get money *right now* for guns and tanks and planes and ships.



France left it to "hit-or-miss" . . . and *missed. Now* is the time for *you* to act! Mail the coupon or write Treasury Department, Section A, 709 Twelfth St. NW., Washington, D. C.

FREE - NO OBLIGATION

Treasury Department, Section A,
709 Twelfth St. NW., Washington, D. C.

Please send me the free kit of material being used by companies that have installed the Voluntary Defense Savings Pay-Roll Allotment Plan.

Name _____

Position _____

Company _____

Address _____

(This space contributed by POWER*)*

POWER PLANT EQUIPMENT

TURBO-GENERATORS

1—10000 KW. West. 2400 V. Cond.
1— 7500 KW. GE. 6600 V. Cond.
1— 5000 KW. GE. 13,200 V. Cond.
1— 4000 KW. GE. 6600 V. Cond.
1— 3000 KW. GE. 600 V. Cond.
1— 2500 KW. G.E. 600 V. Cond.
1— 1400 KW. West. 600 V. L.P. Cond.
1— 625 KW Terry-Allis—600 V. Cond.
1— 500 KW. GE. 2300 V. Mixed P.
1— 500 KW. GE. 600 V. Cond.
1—175 H.P. G.E. Turbine—only

AIR COMPRESSORS

1—1190 Cu. Ft.—IR—2 stage Direct Motor Driven.
1—1580 Cu. Ft.—IR—2 stage Direct Motor Driven.
1— 888 Cu. Ft.—IR—2 stage Steam Driven.
1— 599 Cu. Ft.—IR—2 stage Belted
2— 549 Cu. Ft.—IR—Duplex 35# pressure.
1— 173 Cu. Ft.—IR—ERI Belted.
1— 146 Cu. Ft.—IR—3 stage Belted 2000#

G.E. CENTRIFUGAL COMPRESSOR

Type WM—675—8800/10800.
Volume—8800/10800 Pressure 32/39.6.
Driven by 820 H.P. G.E. Turbine.
Condition excellent.

BOILERS

2—1000 H.P. Heine—275#
2— 600 H.P. B&W—200#
2— 500 H.P. Heine—250#
1— 340 H.P. B&W Sterling—150#
2— 160 H.P. B&W Sterling—155#
1— 167 H.P. HRT—150#
1— 60 H.P. HRT—125#

MOTOR GENERATOR

1—75 KW. West. 2200/250 V. 3-wire, CI.

BELTED GENERATOR

1—500 KW. G.E. 550 V. 225—RPM.

PUMPS

1—4000 GPM, DeLaval Cent. 195 Ft. Head Driven by 300 H.P. G.E., 2200 V. motor
1—3000 GPM, DeLaval Cent. 290 Ft. Head Driven by 300 H.P. G.E., 2200 V. motor
1—1500 GPM, DeLaval Cent. 290 Ft. Head Driven by 200 H.P. G.E., 2200 V. motor
1—1500 GPM, Gould Fire Pump, 231 Ft. Head Driven by 150 H.P. G.E., 2200 V. motor
2—1200 GPM, Worth. Cent., 180 Ft. Head Driven by 75 H.P. G.E., 2300 V. motor
1— 750 GPM, Worth. Fire Pump, 16x9x12 Steam Driven. This item never used.

MOTORS

14—Motors, 25 cycle, 440-550 volts.
H.P. ranging from 15 to 350.

Also transformers, engines and cranes

Send us your inquiries

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The Buyer Must Be Satisfied—Always

SUBSTATION EQUIPMENT

just removed from service

3—**500-KVA**—Single phase—60 cycle **TRANSFORMERS** 33,000 high—440/220 low voltage

1—**400A** — 37,000 Volt — 3 pole outdoor hand operated type **FKO** — 236-A Oil switch

3—**Type OF** — form BO 37,000 volt **LTG ARRESTORS**

ALL GENERAL ELECTRIC MANUFACTURER

H. BLAINE JOHNSON

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FURNACE TRANSFORMERS

4—G.E. Type H Form D.H. **500 K.V.A. 100/11300** volt Circular Coil H Design **55° C.** Rise at at 0.90 P.F. **FURNACE TRANSFORMERS** #1972037, 1972038, 1972039 and 2900496.

C. A. JORDAN, CRANE CO.

4100 S. KEDZIE AVE. CHICAGO

STOCK SHIPMENTS

DIESEL

1—INTERNATIONAL PD-40 Power Unit
60 H.P. F & M 3/60/2300—F & M Gen.
80 H.P. ATLAS—Belted
100 H.P. FULTON—Belted
2—55 H.P. BRUCE MacBETH NAT. Gas Engines
240 H.P. F & M 3/60/2300—F & M Gen.
2—300 H.P. F & M 3/60/2300—F & M Gen.
1—360 H.P. F & M 3/60/2300—F & M Gen.

STEAM

80 H.P. BALL 53 K.W. 125/250 Volt 3 Wire Westinghouse Generator
95 H.P. AMES-Uniflow
125 H.P. SKINNER—Center Crank
300 H.P. RIDGWAY 4 Valve 250 KVA 3/60/2300 Ridgway Generator

Complete Repair and Maintenance Facilities For All Reciprocating Machinery

Beeson Brothers Supply Company

1000 Alhambra Ave. Los Angeles, Calif.

FOR SALE

BOILERS

2—400 H.P. Heine Cross drum water tube boilers, 3½"x16' tubes, delivering saturated steam at 16# gauge; complete with modern brick settings, Liptak arch, soot blowers.

STOKERS

3—Illinois chain-grate stokers, 7' 11"x10' 0" grate surface, natural draft.

STEEL STACK

1—Steel Stack 66" in diameter, 150' high.

Also incidental power plant items, miscellaneous electric equipment, 4" pipe-threading machine, duplex and triplex steam pumps, etc.

The above items displaced on June 15, 1941, on account of changes in power supply. Are available for inspection at our plant at Paris, Illinois.

ILLINOIS CEREAL MILLS, INC.
PARIS, ILLINOIS

Direct Current Generator

1—40 KW C-W Type CCD. 250 v., 1100 RPM.
1—45 KW C-W Type CCD. 250 v. 1100 RPM.
1—25 KW GE Type RC 250 v., 950 RPM Generator.
1—5 KW GE Type CD 250 v. M G Set.
1—45 KW GE Type ATB Form P.B. 550 v., 3 ph. Alternator.

MILTON WERBY & CO.
423 Atlantic Ave. Boston, Mass.

Condensing Turbine Unit

375 KVA G. E., 4 Stage, Form B, 200 lb. steam, 240 Volts, 3 phase, 60 cycle, 3600 RPM, equipped with S & K multi-jet condenser, without exciter, with 1200-amp. Condit oil breaker, with two Goulds condenser pumps and common base, but without motor.

CONTINENTAL-DIAMOND FIBRE COMPANY
NEWARK, DELAWARE

HIGH-PRESSURE BOILERS

"New and Used — NOT Abused"!

JOE SULLIVAN CO.

523 N. Hamlin Ave. CHICAGO, ILL.
Phone—VanBuren 8669

AIR COMPRESSORS FOR SALE

2300 Cu. ft. I-R Steam driven
2000 Cu. ft. Nordberg Steam driven
1000 Cu. ft. I-R Steam driven
2500 Cu. ft. I-R Motor driven
2000 Cu. ft. I-R Motor driven

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B&W BOILERS

Immediate Delivery

200# pressure with superheaters
375 H.P. each F.O.B. St. Louis
500 H.P. Heine battery two.
400 H.P. Heine battery two.
150 H.P. Heine 180# pressure.
80 H.P. Economic boilers.

H. A. Woodworth Engineering Co.
ST. LOUIS, MO.

AVAILABLE IMMEDIATELY

One—410 h.p. **Riley "Ring Flow" 4 Drum Boiler**, A.S.M.E. 160#, full water cooled furnace for P.C., oil or gas firing, six years old, A-1 condition.
One—500 h.p. **Keeler "CP" Boiler**, A.S.M.E. 160#, full water cooled furnace for P.C., oil, or gas firing, two years old, A-1 condition, full steel cased setting.
One—**Riley Atrita No. 4 pulverizer** with geared turbine drive and 4 speed F.D. fan.
One—**Riley Atrita No. 3 pulverizer** with A.C. motor drive and 4 speed F.D. fan.

Full specifications upon request.

THE AMERICAN OAK LEATHER COMPANY
Cincinnati, Ohio

FOR SALE

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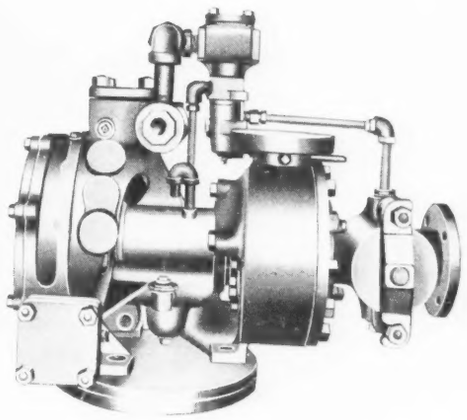

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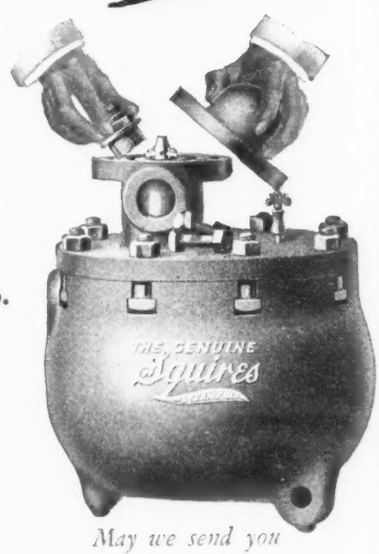

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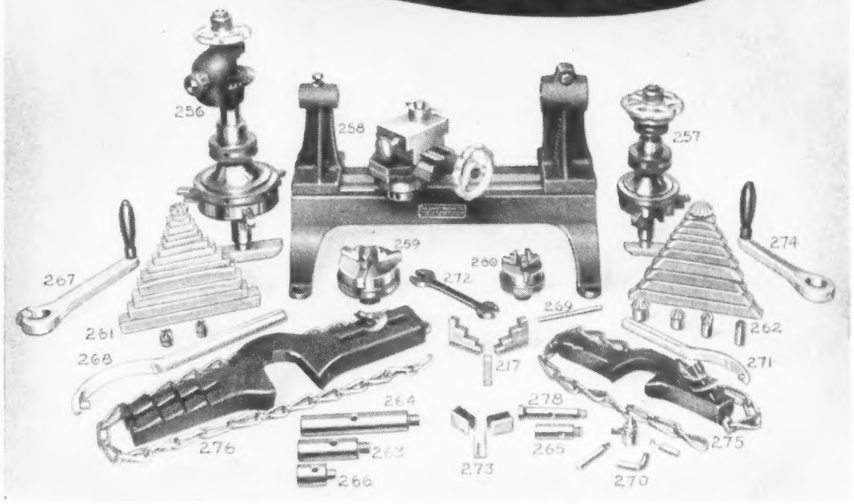
will make a lot of different size valves LAST LONGER!



FOR EXAMPLE the No. 6 T-L Globe Valve Reseating Outfit (shown above) has a capacity range for reseating flat and taper seated globe valves from 1/4 to 6".

Another widely used outfit for globe valves is the No. 8 T-L with a capacity from 1/4" to 8" inclusive.

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Use hand wheel for opening and closing valves—not bars or wrenches.

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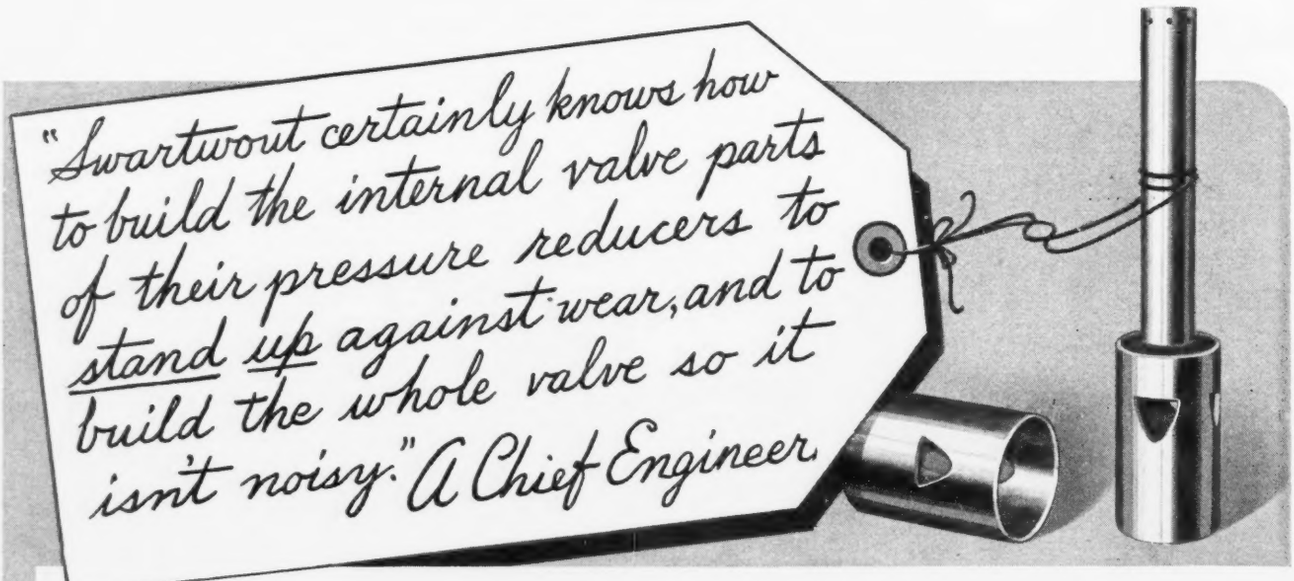
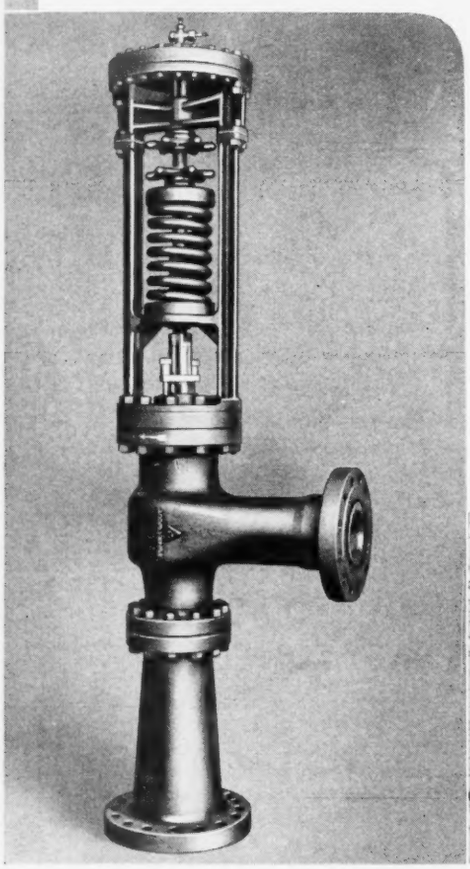
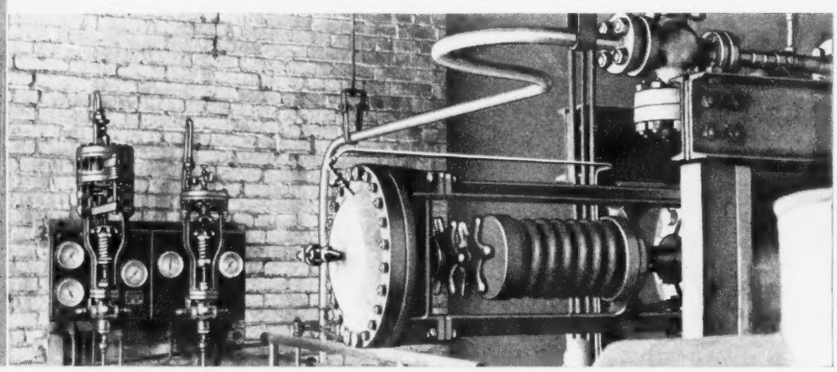

"Swartwout certainly knows how to build the internal valve parts of their pressure reducers to stand up against wear, and to build the whole valve so it isn't noisy." A Chief Engineer

Seven years without a penny of maintenance expense— a record you too can enjoy with Swartwout Equipment



DEPENDABILITY you can bank on is built into every piece of Swartwout Equipment. You save on maintenance, and enjoy continuous trouble-free operation • The chief engineer of a large industrial plant using Swartwout 1500 lb. standard Reducing and Desuperheating Equipment tells visiting engineers there has been no expense on the seat and disc in seven years. The valve operates every week-end and whenever the high pressure turbine is off the line—reduces initial 1250 lb. steam to 236 lbs. Opened for inspection after the first three years, the Stellite coated contact surfaces showed no wear—only a high polish • Swartwout engineers gladly discuss your needs with you or your consultants, assume unit responsibility for your reducing and desuperheating installation.

LEFT: Swartwout Reducing Valve. **BELOW:** Swartwout Master for Reducing Valve and Differential Control for water supply. Swartwout F. W. Regulators serve the boilers.



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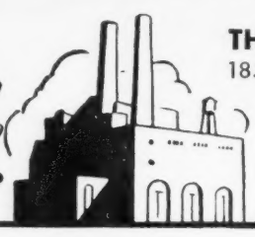
Master Controls • Reducing Valves • Separators • Exhaust Heads

Swartwout

•Power Plant Equipment•



THE SWARTWOUT COMPANY
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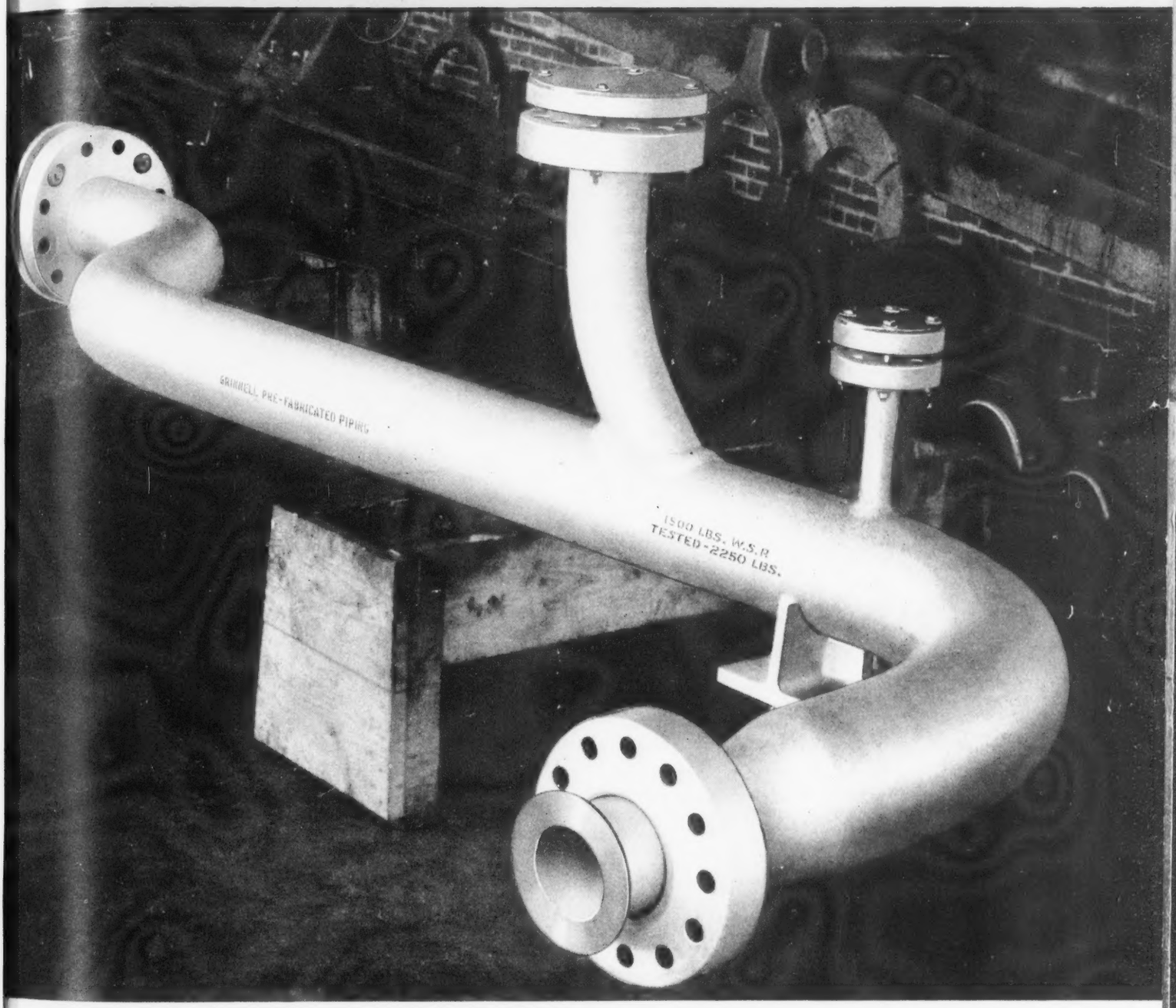
★ ★ ★

Controlled **AIR CIRCULATION**
for Power Plants and Industrial Buildings

HOW TO *Sub-Contract* YOUR PIPING PROBLEMS!



WHEN defense orders necessitate added power piping in your plant, take this short-cut through the special engineering and prefabrication problems that precede installation. "Give the plans to Grinnell", and you'll "sub-contract" all the questions and troubles of interpreting super-pressure steam requirements into super-power piping.

Grinnell engineers are power specialists, qualified by long experience to interpret even the most complex power problems into speedily-erected, underwriter-approved piping systems. Grinnell plants, strategically located to serve defense industries, are equipped with every last facility to prefabricate these vital systems.

Grinnell is helping leading manufacturers, utilities and process plants to meet defense needs for added power. Write for Data Book, "Grinnell Prefabricated Piping". Grinnell Company, Inc., Executive Offices, Providence, R. I., Branch Offices in principal cities.

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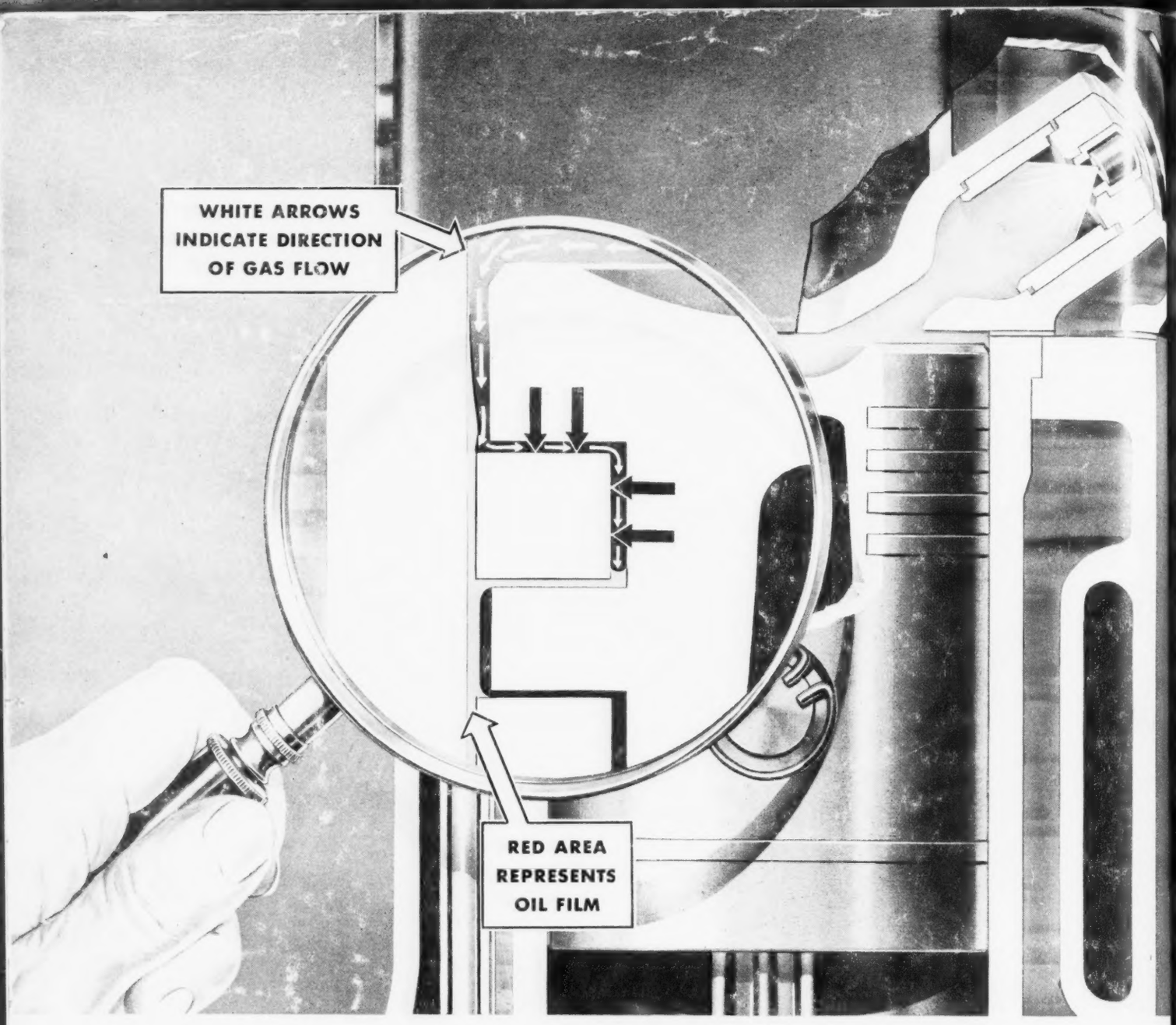

Defense Against a Flaming "Push"

THE "CORRECT" ANSWER TO A TOUGH PROBLEM IN DIESEL OPERATION:

PROBLEM: See those black arrows under the magnifying glass above? They show how the force of firing inside a Diesel engine cylinder pushes against the top piston ring. That "push" may be stronger than 600 lbs. per sq. inch. Temperatures here are "very high." Under such conditions, costly wear and power-wasting "blow-by" may result—unless the cylinder walls and ring surfaces are given *special* protection.

The problem here is to choose the right oil to defend your particular Diesels against this "flaming push" exerted on piston rings.

ANSWER: The *correct* oil for this job must maintain a tough film between the rings and cylinder walls and between the rings and their grooves. This film must not be ruptured by the crushing pressure. It must not oxidize to form ring-sticking deposits under the scorching heat. *Gargoyle D.T.E. Oils 1-to-5* are made to do this job in intermediate and large Diesel engines.

Delvac 500 Series Oils are equally efficient in small, high-speed Diesels. *Delvac 700 Series Oils* have been approved by the Caterpillar Tractor Co. for use in its engines.

GARGOYLE
Lubricants